Water Plant Optimization Study

ST. THOMAS ELGIN AREA WATER TREATMENT PLANT

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WATER PLANT OPTIMIZATION STUDY

St. Thomas
Elgin Area Water Supply System

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Please note that some of the recommendations contained in this report may have already been completed at time of publication. For more information, please contact the local municipality, or the Water Resources Branch of the Ministry of the Environment.

SUMMARY OF FINDINGS AND RECOMMENDATIONS

1.0 INTRODUCTION

This report on the St. Thomas (Elgin Area) Water Treatment Plant Optimization Study was prepared by MacLaren Engineers Inc. on behalf of the Ontario Ministry of the Environment under Agreement dated December 10, 1986.

The project is a result of the Drinking Water Surveillance Program (DWSP) being carried out by the Ministry of the Environment on municipal water supplies. Under this program, which began on April 1, 1986, a continuously updated base of information is being established on Ontario water plants and water quality. The Water Plant Optimization Study (WPOS) program was initiated for each water plant entering the program in order to complement the data generated from the Drinking Water Surveillance Program.

Terms of Reference for the Water Plant Optimization Study were prepared by the Ministry of the Environment. The purpose of the study is to document and review present conditions and determine an optimum treatment strategy for contaminant removal at the plant, with emphasis on the removal of particulate materials and disinfection processes. To maintain a current database of information, it is envisaged that the WPOS report will be updated on an annual basis.

As a supplement to the Water Plant Optimization Study for the St. Thomas (Elgin Area) Water Treatment Plant, a separate report was prepared on the existing waste management practices at the plant. The report provides an overview of the existing treatment facilities and includes sections on sources of wastes, waste characteristics, present disposal practice and estimates of capital and operating costs for the existing treatment works. The report was prepared by MacLaren Engineers Inc. for the Ministry of the Environment under the title: Wastewater Disposal Study, St. Thomas (Elgin Area) Water Supply System, August 1988.

2.0 HIGHLIGHTS OF STUDY

2.1 Raw Water Quality

The St. Thomas (Elgin Area) Water Treatment Plant is located on the shoreline of Lake Erie near Port Stanley.

Raw water is drawn from Lake Erie through an octagonal-shaped crib and 1527 mm diameter reinforced concrete pressure pipe. The crib is located 1189 m off shore in 9.2 m of water at average lake level and has a depth of submergence of 6.7 m.

The lake water is generally of good quality with the exception of turbidity which varies widely from day to day. Monthly average turbidity varies form 60 FTU to 90 FTU. Greater fluctuations are experienced in daily values which vary from 2.7 FTU to 424 FTU. Higher turbidity values generally occur in the periods March through May and September through December.

Chemical water quality data evaluated showed that the raw water has the following characteristics: pH generally being above 8 units (range 7.7 to 8.6); alkalinity ranging from 95 to 124 mg/L as $CaCO_3$; hardness varying from 120 to 139 mg/L as $CaCO_3$; total ammonia ranging from 0.009 to 0.101 mg/L as N with an average for the study period of 0.032 mg/L as N.

Bacteriological water quality of the raw water source is good in relation to existing standards. Data indicate that majority of tests have a total coliform count in the range 0 to 100 per 100 mL and a fecal coliform count in the range of 0 to 10 per mL.

2.2 Flow Measurement Accuracy

The majority of primary flow elements consist of magnetic flow meters (raw water, treated water west header, service water). Other elements comprise one ultrasonic flow meter (treated water east header) and various Venturi flow tube meters (filter effluent, filter-backwash water).

The raw water magnetic flow meters have not been re-calibrated since they were installed in 1967-68. But review of the data has revealed no inconsistencies in the flows from month to month and year to year. The treated water flow meters have also not been re-calibrated since they were installed (1967-68 magnetic, 1986 ultrasonic); however, no inconsistency in the flow data record was evident. Service water is taken off the east and west discharge headers before the treated water flow meters and is metered by a Fisher & Porter 150 mm diameter magnetic flow meter. Filter backwash water is taken from the treated water pump well and is not included in the treated water flow pumped to the distribution system. Filter backwash water is metered by a 600 mm diameter Venturi tube differential pressure flow meter.

2.3 Plant Capacity and Process Design

The St. Thomas (Elgin Area) Water Treatment Plant was constructed from 1966 to 1968 with an initial capacity of 45,460 m^3/d and an ultimate capacity of 90,920 m^3/d. Provisions were made for expansion to 181,840 m^3/d.

The plant design uses the conventional treatment process consisting of rapid mixing, two-stage flocculation, sedimentation and gravity, high rate, dual media filtration. Water is pumped from the Low Lift Pumping Station through a 900 mm diameter concrete pressure main to the plant 1.4 km north. At the plant the flow is split into two 400 mm diameter supply pipes which feed two parallel pretreatment modules (rapid mixing, flocculation, and sedimentation tanks). Pretreatment modules are interconnected after rapid mixing as well as after sedimentation for flexibility in operations of the plant.

2.4 Process Automation

The plant is equipped with instrumentation for automatic or manual operation of the plant and pumping equipment. Automatic control equipment consists of analogue instrumentation, which for the most part, is no longer used. As such, plant operations are essentially manual except for the filters, which are operated on a semi-automatic basis, and chemical feed systems, which include automatic proportional-to-flow controllers.

2.5 Plant Operations

The plant is operated on the basis of remote manual and local manual control. An analogue supervisory control system allows the plant to be run automatically except for the chemical feed systems which must be initiated manually. The backwash cycle is initiated by the operator. Once initiated filter backwashing is done automatically and is controlled by an analogue filter backwash controller.

The plant operates on the basis of 2-12 hour shifts, 7 days per week. Two operators are on duty during the day shift and one operator mans the night shift. The day shift operators are supported by the Superintendent and Assistant Superintendent. On the day shift, one operator staffs the control room while the second operator monitors plant operations, carries out water quality tests, sets chemical feed rates, confirms the accuracy of on-line monitors, receives chemical deliveries, and backwashes filters.

2.6 Process and Quality Control

The plant operator is responsible for process and quality control, and maintains the daily log sheet. Chemical water quality testing is done by the operator in the plant laboratory, whereas water examination for bacteriological and biological parameters is done routinely at the MOE's laboratories.

3.0 PLANT PERFORMANCE

3.1 Particulate Removal

Treated Water quality during the study period has consistently met the established Ontario Drinking Water Objective of 1.0 FTU for turbidity. Effluent turbidity varied from 0.11 to 0.17 FTU with an average of 0.14 FTU. Based on the low effluent turbidity (high percentage removal), and the fact that no filter breakthrough occurred prior to reaching terminal headloss, the alum dosages are suspected to be at or near optimum levels.

3.2 Disinfection

Prechlorination was practiced at an average dosage of between 1.3 mg/L to 1.5 mg/L for an average total chlorine residual of 0.76 mg/L after the filters. At the 1986 average day flow a total contact time of 5.0 hours to 9.4 hours is available. This long contact time is beneficial to the disinfection process, however, it provides increased opportunity for the formation of trihalomethanes (THMs). The levels of THMs formed at the St. Thomas plant are relatively low in comparison with the current Ontario Drinking Water Objective of 350 µg/L and ranged from 22 to 71 µg/L with an average of 45 µg/L over the 3 year period.

Postchlorination is applied in the high lift pump suction conduit which, together with the pump wet wells, has a detention time of 50 minutes at the design flow rate. Dosages range from 0.2 mg/L to 0.7 mg/L. Variations are due to changes in the chlorine demand and the plants objective to maintain a total chlorine residual of 0.9 to 1.0 mg/L in the treated water pumped to distribution.

Based on the bacteriological test results for raw and treated water, it was concluded that the disinfection practice at the St. Thomas (Lake Erie) Water Treatment Plant was very efficient and that no immediate improvements need to be made to the process. A downward adjustment of the high raw water pH during the summer could be considered to improve the efficiency of disinfection, although any inefficiency that may exist at high pH appears to be compensated for by the long contact times available in pre- and postchlorination.

3.3 Taste and Odour Control

Treated water is informally examined by the operators for objectionable taste and odour by simply sniffing and tasting the water. Although no problems were reported for the study period, some taste and odour problems did occur in the past on a seasonal basis during periods when the raw water contained elevated levels of algae, primarily Diatoms and some Flagellates that predominate during the summer months.

Powdered activated carbon is used to control taste and odour. The carbon is dosed in the rapid mix as a slurry. No formal odour threshold number has been established and the operators have developed a basic dose guide chart based on qualitative tests and experience.

3.4 Aluminum in Treated Water

The average dissolved aluminum content in the treated water varied from 0.008 to 0.04 mg/L over the three years. For the same period, the treated water pH ranged from 7.2 to 7.59 units.

Comparison of these results to other treatment plant outputs reveals that dissolved aluminum residuals were very low, and are substantially less than the value of 0.27 mg/L theoretically attainable at equilibrium in a pure system at pH 7.7 (Amirtharajan and Mills, 1982 after Rubin and Kovac, 1974).

In view of the low aluminum residual values in both the raw and treated waters obtained from the plant tests, it is suggested that the test procedure be reviewed and water samples submitted to an independent outside laboratory for confirmation of the in-house test results.

3.5 Stability of Water

On the basis of the Langelier Saturation Index it was determined that the water is slightly corrosive after treatment.

4.0 RECOMMENDATIONS

4.1 Physical Improvements

Apart from one exception as noted below, no physical improvements need to be undertaken at the St. Thomas (Elgin Area) Water Treatment Plant with respect to particulate removal and disinfection.

In order to facilitate monitoring of the post-chlorination dosage it is recommended that a separate weigh scale for postchlorination service be installed.

4.2 Studies

a) Operations and Process Control

1. Initiate a flow meter calibration programme to verify the accuracy of existing meters and, if necessary, to recalibrate flow meter instrumentation.

2. Prepare and maintain an up-to-date process piping flow diagram at the plant.

3. Operate both pretreatment modules during peak summer demand periods.

4. In the calculation of the applied alum dosage, a concentration factor of 649 kg/m^3 for the alum solution is currently being used. For commercial strength alum solution (48.18% alum by weight, S.G. of 1.33) the correct factor is 640.8 kg/m^3. This value (640.8 kg alum per m^3 of solution) should be adopted for future calculation of the applied alum dosage.

5. Confirm the accuracy of the sodium silicofluoride loss-of-weight recorder and verify analytical test results for fluoride obtained with the plant lab spectrophotometer.

6. Results of dissolved aluminum in the raw and treated water are very low. The validity of the results should be confirmed by verification of test procedures and confirmation of results with an outside laboratory.

7. Consideration should be given to reducing the aggressiveness of the treated water.

8. The wash water consumption as a percentage of treated water flow is higher than normal and validity of the records and methods of reducing the amount of the backwash water used should be investigated.

9. The filter media should be inspected at regular intervals; perhaps as often as every six months.

b) Particulate Removal

1. Continuous Monitoring of Optimum Coagulant Dosage

Investigate the benefits of using a Streaming Current Detector with strip chart recorder to monitor the optimum coagulant dosage as determined in the laboratory by jar tests and/or streaming current titrations.

2. Flocculant Aid

Investigate the benefits of using a polyelectrolyte as a flocculant aid in the treatment process.

Benefits to be derived from using a flocculant aid include:

1) the need for a lower alum dosage hence the production of less alum sludge requiring treatment and disposal.

2) production of a faster settling floc with better filtering characteristics.

3. Filter Preconditioning

Several studies have shown that filter preconditioning with a polymer or coagulant will result in lower levels of turbidity breakthrough and for a shorter duration, in a filter at start-up following a wash. This procedure, which can be achieved by adding a polymer to the rinse cycle of the filter backwash, should be investigated for possible implementation.

4. Filter Operation

In order to reduce filter breakthrough after a wash, management should investigate letting a filter rest for about 15 minutes after a wash before returning the filter to service.

An additional way of reducing filter breakthrough after start-up is to filter to drain. This procedure should be investigated, at reduced filter rates, using the manually controlled filter drain pipe. If the procedure proves to be successful, further studies will have to be carried out to determine requirements for the installation of filter to drain piping capable of handling the design flow rate of the filter.

c) Disinfection

1. Adjustment of Raw Water pH

Improve the efficiency of disinfection by lowering the raw water pH to about 7.2 to 7.4. This may be achieved by using acidified alum as a coagulant. Treatment at a lower raw water pH would have additional benefits such as: 1) improvement in the efficiency of alum coagulation, and 2) reduction in the aluminum carry-over in the treated water.

Sulphuric acid could be considered as an alternate chemical for pH reduction.

4.3 Other Recommendations

a) Particulate Removal

Modify Rotodip alum feeders to provide for automatic dosage control relative to the Streaming Current Detector output signal.

b) Disinfection

At the present there are no problems with bacteria in the distribution system. Effective control is achieved by maintaining a high chlorine residual in the water leaving the plant and, in the case of the Port Burwell supply, by re-chlorinating the water at the elevated tank. An alternate method, practiced by large municipalities in Ontario to control microorganisms in the distri-

bution system, is to postammoniate the treated water at the plant. This technique should be considered for application at the St. Thomas plant if problems with bacterial growth and the development of taste and odour should be experienced in the distribution system.

ACKNOWLEDGEMENTS

Members of the Project Committee for the St. Thomas Elgin Area Water Supply System are listed on the fly-sheet of this report. The cordial assistance provided by each of these members during the course of this study is hereby gratefully acknowledged. To all others who have assisted us in any way, we express our sincere thanks.

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LIST OF SYMBOLS AND ABBREVIATIONS

Symbols Used

d	day
h	hour
min.	minute
s	second
m	metre
mm	millimetre
cm	centimetre
m^2	square metre
m^3	cubic metre
L	litre
mL	millilitre
kg	kilogram
mg	milligram
g/L	microgram per litre
L/h	litre per hour
L/min.	litre per minute
L/s	litre per second
m/s	metre per second
m/h	metre per hour (filter rate or surface overflow rate equal to $m^3/h.m^2$)
m^3/d	cubic meter per day
kg/h	kilogram per hour
°C	degree Celcius
FTU	Formazin turbidity unit
NTU	Nephelometric turbidity unit
ACU	apparent colour unit
TCU	true colour unit
A.S.U. per ml	areal standard units per millilitre (ASU/mL)
s^{-1}	mean velocity gradient, metre per second per metre
rpm	revolution per minute
V	volt
A	ampere
kVA	kilovolt ampere
kW	kilowatt
>	greater than
<	less than
%	per cent

Abbreviations Used

DWSP	Drinking Water Surveillance Program
MOE	Ontario Ministry of the Environment
WPOS	Water Plant Optimization Study
Al	aluminum
Alum	aluminium sulphate
A.S.U. per mL	areal standard units per millilitre
$CaCO_3$	calcium carbonate
Cl_2	chlorine
N	nitrogen
NH_3	ammonia
SO_2	sulphur dioxide
PACl	polyaluminum chloride
E.S.	effective grain size
U.C.	uniformity coefficient
L.I.	Langelier Saturation Index
MF	membrane filter technique for enumerating bacteria in water
pH	expresses the intensity of the acid or alkaline condition of a solution
p.f.	power factor
SWD	side water depth
THM	Trihalomethane
TTHM	total trihalomethane

INTRODUCTION

AND

TERMS OF REFERENCE

INTRODUCTION AND TERMS OF REFERENCE

1. BACKGROUND

The Ontario Ministry of the Environment has instituted a Drinking Water Surveillance Program. The Program began on April 1, 1986 and encompasses all municipal water supplies in Ontario. The primary objectives of the DWSP for Ontario are to establish a reliable database on water quality which will encompass a wide range of parameters, including pesticides and organic compounds, and to maintain information current by continuously updating the database. In connection with the DWSP, a plant investigation and process evaluation study is initiated for each plant entering the program. A major goal of the study is to document information on the plant's process design and operations, and to determine an optimum treatment strategy for contaminant removal at the plant. It is intended to update the study on an annual basis in order to maintain the database current. The information from these studies will allow valid water quality data to be collected. The results will further identify potential problem areas, serve as the basis for remedial action, and provide a framework for defining contaminant levels and trends.

2. TERMS OF REFERENCE

A detailed Protocol for the Water Plant Optimization Study has been prepared by the Ministry for use by the consultants engaged for the Optimization Studies. This study of the St. Thomas (Elgin Area) Water Treatment Plant has been conducted in accordance with the Protocol. The main objective of the plant investigation and process evaluation study is:

"To review the present conditions and determine an optimum strategy for contaminant removal at the plant, with emphasis on particulate materials and disinfection Processes."

To meet this objective, Terms of Reference (see Appendix D) were prepared consisting of eight specific work tasks which require the consultant to examine, in detail, three years of daily and monthly

operating data, prepare a comprehensive assessment of plant operations and the level of performance achieved, and to provide recommendations for short and long-term modifications in order to obtain optimum disinfection and contaminant removal.

As a supplement to the plant optimization study, the consultant was commissioned to prepare a separate report on the handling and disposal of wastewaters generated at the plant.

3. ST. THOMAS ELGIN AREA WATER SUPPLY SYSTEM

The St. Thomas (Elgin Area) Water Treatment Plant is operated on a continuous basis by the Ontario Ministry of the Environment to supply drinking water to the City of St. Thomas, the Ford of Canada Car Assembly Plant at Talbotville, the Villages of Port Burwell and Vienna and the Townships of Malahide, Yarmouth Southwold and Bayham. The total population of the service area is about 32,000. For a breakdown of the population by service area and a discussion on per capita water consumption reference is made to Section B.3.

The treatment plant was designed and constructed on the basis of the conventional treatment process for particulate removal which comprises rapid mixing, flocculation, sedimentation and gravity filtration. Chemical treatment processes consist of coagulation, disinfection, control of taste and odour, and fluoridation.

Pretreatment units (rapid mixing, flocculation, and sedimentation) are divided into two modules which can be operated individually or together using coagulated water after rapid mixing. To-date only one pretreatment module has been used at anyone time because water production requirements so far have been low. Tanks in service are alternated every three months corresponding to the schedule for manual clean-out of the sedimentation basins. A common settled water conduit at the end of the two sedimentation basins serves the four filters. At the mid-point in the conduit (between the two sedimentation tanks) a sluice gate exists whereby flow from sedimentation tanks 1 and 2 can be isolated to supply settled water to filters 1 and 2 and 3 and 4

respectively. Plant practice is to use a common settled water conduit to feed two, three or four filters simultaneously depending upon the level of plant flow.

SECTION A

RAW WATER SOURCE

SECTION A - RAW WATER SOURCE

A.1 SOURCE

The St. Thomas (Elgin Area) Water Treatment Plant is located on the shoreline of Lake Erie near Port Stanley. Water is drawn from the lake via a 1524 mm diameter reinforced concrete pressure pipe extending 1189 m into the lake. The octagonal-shaped intake crib, constructed of fabricated steel, is located in 9.2 m of water at average lake level and has a depth of submergence of 6.7 m.

A.2 QUALITY

Lake Erie water in the region of the plant intake generally is of good quality with the exception of raw water turbidity which varies widely from day to day. Extensive records are being kept by the plant. Those for the period 1984 to 1986 are presented in the protocol tables for the Optimization Study attached to the end of this report. A summary of the data for several parameters is presented in the following table to express general water quality conditions. A more detailed discussion of various water quality parameters follows.

a) Physical Parameters

Turbidity: The average monthly turbidity varies from a low of 6.0 FTU to a high of about 90 FTU. Greater fluctuations occur in daily values which vary from 2.7 FTU to 424 FTU. The overall average for the three-year record is 35 FTU. Higher turbidity values generally occur during the periods March through May and September through December.

Colour: Colour is a measure of the clarity of the water. At the St. Thomas plant intake, lake water colour varies moderately. The data record indicates a monthly variation of 1 to 36.5 HzU with an average of 7.8 HzU.

Temperature: Raw water temperature is measured once per day at the plant. Daily temperature extremes during the year range from 3°C to 24°C. The yearly average temperature is in the order of 12°C.

Taste and Odour: Taste and odour tests are performed on raw water several times per day. Taste problems that occur relate to the presence of algae primarily Diatoms and some Flagellates that predominate during the summer months.

b) Chemical Parameters

pH Value: The average monthly raw water pH generally is above 8.0 units and ranges from 7.7 to 8.6 units. A maximum value of 8.3 has been recorded. The greatest fluctuations occur during the algae growing season from May to September.

Alkalinity: Total alkalinity is relatively constant ranging from 95 to 124 mg/L as $CaCO_3$. The monthly average alkalinity value for the study period is 103 mg/L.

Hardness: The raw water hardness has a monthly average of 128 mg/L as $CaCO_3$. Little variation in this value has been observed, the range being from 120 to 139 mg/L. At this level of hardness the water may be classified as being moderately soft to hard.

Total Ammonia: The range of total ammonia content in the raw water is from 0.009 to 0.101 mg/L as N and the average for the period of record is 0.032 mg/L as N. This level of ammonia is not high and falls within the range of concentrations normally found in natural surface waters.

c) Microbiological Parameters

(i) Bacteriological Water Quality

Bacteriological water quality is good in relation to existing Standards. Normally two samples of raw water per week are analyzed for total and fecal coliform organisms. Treated water is analyzed four times per week for the same organisms as well as for standard plate count.

TABLE A.1

LAKE ERIE RAW WATER QUALITY CHARACTERISTICS

AT THE ST. THOMAS WATER TREATMENT PLANT

	3-Year Summary, 1984 to 1986	
	Range	Average
Turbidity, FTU	2.7 - 424	35
Colour, HzU	1.0 - 36.5	7.8
pH, Units	7.7 - 8.6	8.0
Temperature, °C	3 - 24	12
Alkalinity as $CaCO_3$, mg/L	95 - 124	103
Hardness as $CaCO_3$, mg/L	120 - 139	128
Total Ammonia as N, mg/L	0.009 - 0.101	0.032
Total Coliform, (MPN) range per 100 mL	0 - 5,000	0-100
Fecal Coliform, (MPN) range per 100 mL	0 - 10	0-10
Algae, A.S.U. per mL	30 - 1,146	300

Coliform Organisms: Data indicate that the majority of tests undertaken have a total coliform count in the range of 0 - 100 per 100 mL and fecal coliform count in the range of 0 - 10 per mL.

(ii) Nuisance Organisms (Algae)

Algae analyses were carried out on two raw water samples per month during the period January to September 1984 at the MOE laboratory. Results indicate average algae counts of 73 to 711 A.S.U. per mL with higher values occurring during the summer months. The range in algae counts observed varies from 30 to 1146 A.S.U. per mL. Dominant algal species identified include Diatoms, Flagellates, and some Greens and Blue-Greens with Diatoms being most abundant.

A.3 SECURITY OF INTAKE

Lake Erie at Port Stanley is a good raw water source and there are no plans for protection of the intake. There are no major outfalls from sewage treatment plants or industries upstream of the intake. The potential for contamination of the source water by a major spill also appears to be very low since commercial shipping lanes are far away from the intake.

SECTION B

FLOW MEASUREMENT

SECTION B - FLOW MEASUREMENT

B.1 METHOD OF MEASURING FLOWS

Flows are measured for:

- raw water - the low lift pump discharge to each of two pretreatment modules
- filter effluent - each individual filter
- filter backwash water - backwash water pump discharge
- service water
- plant output - 1) high lift pump discharge in east and west discharge headers
  2) by revenue meters in distribution system.

Primary flow elements consist of:

- magnetic flow meters:	• raw water • treated water, west header • service water
- ultrasonic flow meter:	• treated water, east header
- Venturi flow tube:	• filter effluent • filter backwash water
- magnetic flow meters and 1 Dall tube:	• distribution systems • revenue meters.

Table B.1 lists information on existing flow meters and associated instrumentation. The sizes and capacities of the various flow meters are also given.

All Venturi flow meters are fitted with differential pressure transmitters which supply the linear flow signal to locally and remotely mounted indicator-totalizers and recorders as listed in Table B.1.

Raw water is supplied by a single 760 mm diameter pipe from the Low Lift Pumping Station. At the plant, flow is split in two with individual branch headers (400 mm dia.) supplying each half section of the pretreatment basins (rapid mix, flocculation, and sedimentation tanks).

Flow is metered in each branch header by a Fisher & Porter 350 mm dia. magnetic flow meter. Instrumentation includes individual locally mounted totalizers and percent flow read-out gauges. The main control panel includes individual indicators, a summator, combined flow totalizer and recorder.

To-date only one-half of the plant has been used, alternately, at any one time due to low flows. Hence, only one or the other magnetic flow meter would be in use. Recording of flow is done daily by reading the main control panel totalizer each day at midnight. Entries are logged in cubic meters.

Raw water represents the total daily flow taken into the plant, while treated water represents the total daily amount of water pumped into the distribution system.

Individual filter effluent pipes are equipped with a flow meter and rate control valve. The flow signal is used for filter rate control, automatic pacing of the post chlorinator, and for monitoring total filtered water flow. A summator, totalizer and recorder are located on the main control panel.

The total in-plant water usage is measured and recorded, but no specific flow meter is available for monitoring the water used by the filter surface wash agitators.

The filter backwash water is measured by Venturi flow meter in the common discharge header from the backwash pumps. The flow signal is used for monitoring purposes and for automatic control of the backwash water flow rate.

High lift pumps discharge treated water to the distribution system via two 600 mm diameter discharge headers, the east and west discharge headers, which combine into a 760 mm diameter pipeline in the yard to the north of the plant. Originally, 350 mm diameter Fisher & Porter magnetic flow meters were installed on each of the two discharge headers. Early in 1986 the magnetic flow meter in the west header was replaced with a 350 mm diameter ultrasonic flow meter supplied by

TABLE B.1

FLOW METERING EQUIPMENT

SERVICE	NUMBER	TYPE & CAPACITY RANGE	LOCATION	INSTRUMENTATION
1. Raw Water	2	· 350 dia. F & P mag. meter, Model 10D1420A (units MIGD) · 4,550 to 45,500 m^3/d	· raw water pipe gallery · 1 meter on each raw water header feeding each half of plant	· local: - F & P totalizer, m^3 x 5 - % flow readout, 0-100% · remote ([1]): - individual indicators, summator, totalizer, recorder
2. Filter Effluent	4	· 400 dia. Venturi, F & P, · 0 to 34,000 m^3/d	· filter pipe gallery	· local: indication · remote: - summator, totalizer, recorder
3. Treated Water	2	· 1-350 dia. F & P mag. meter · 1-350 dia. Ultrasonic flow meter, Model A500 by Bestobell Sparling · 4,550 to 45,550 m^3/d	· High lift pumps - East discharge header · West discharge header (installed Spring 1986)	· local: - F & P totalizer, m^3 x 5 - % Flow indication, 0-100% · remote: - summator, totalizer, recorder
4. Service Water	1	· 150 dia. F & P mag. meter · 460 to 46,000 m^3/d	· High lift pumping station on service water header off E & W plant discharge pipes (before flow meters)	· local: - F & P totalizer, m^3 x 5 - % Flow readout, 0-100% · remote: - recorder, totalizer
5. Filter Washwater	1	· 600 dia. Venturi, F & P, 0-9.0 x 10^4 m^3/d · 12,500 to 125,000 m^3/d	· filter pipe gallery	· local: indication, m^3/d · remote: - totalizer, recorder - filter control console
6. Distribution System:				
A. Port Burwell	1	· 150 dia. F & P mag. meter · 410 to 4,600 m^3/d	· in meter chamber on Port Burwell pipeline-East of W.T.P.	· remote - totalizer, recorder
B. Booster Pumping Station (at Centennial Ave. Reservoir)	1	· 760 dia. Dall Tube	· on 760 dia. discharge from pumping station	· local: · remote: - totalizer, recorder
C. St. Thomas	2	· F & P mag. meter	· flow meter chambers on E. & W. supply pipelines	· local: · remote: totalizer, recorder (each meter)
D. Ford Motor Company	1	· F & P mag. meter	· flow meter chamber on 600 dia. supply header (downstream of elev. tank)	· local: · remote: totalizer, recorder

[1] On Main Control Panel at W.T.P.

Note: Billings to municipalities are based on water meter readings of distribution system flow meters.

"Bestobell Sparling". Instrumentation on both meters include local totalizer and percent flow indication with summator, totalizer and recorder on the main control panel.

B.2 ACCURACY OF FLOW MEASUREMENTS

Flow meter accuracy has been assured by the use of Venturi tube primary flow elements for filter effluent flow and magnetic flow meters on raw and treated water. The Venturi flow tube typically has a specified accuracy of one-half of one percent at mid-range of actual flow and one percent at the extremeties of the flow range. Similar accuracies are obtained with magnetic flow meters. Ultrasonic flow meters are less accurate and have a specified flow accuracy of 1 to 5 percent.

Transmitting instruments and totalizers are generally subject to additional errors. Transmitters at the plant have a specified accuracy of one-half of one percent of actual differential pressure. The specified accuracy for totalizers is one percent.

Using the above specifications, the maximum flow meter error of Venturi tube and magnetic flow meters should not exceed two and one-half percent of actual flow. This error may increase by one-half of one percentage point for multiple meters with summated flow signals. The range in meter error for the ultrasonic flow meter could be two and one-half to six and one-half percent.

a) Raw water

The raw water meters have not been re-calibrated since they were installed in 1967-68; hence their present accuracy is unknown. In reviewing the data of Table 1.1 however, no inconsistency in daily flows can be identified. Monthly daily average, minimum and maximum values also appear consistent from month-to-month and year-to-year.

The consistency in raw water pumpage rates is further demonstrated by the yearly summary, given below, for maximum, minimum, and average flows (derived from monthly average flows).

Yearly Summary of Raw Water Flows, ML/d

	1986	1985	1984
Average Day	24.88	24.74	23.16
Maximum Day	38.09 (June)	35.22 (Aug.)	32.08(Sept.)
Minimum Day	13.63 (Dec.)	14.27 (Jan.)	12.04(Dec.)

In reviewing minimum flows, it is noted that very low flows are recorded for January and December. Such low flows generally occurred on a Sunday or Statutory Holiday which seems to explain why they differ significantly from flows occurring on days that bracket the low flow event.

b) Treated Water

As for the raw water meters, treated water flow meters have not been re-calibrated since they were installed (1967-68 magnetic meter, 1986 ultrasonic meter).

Plant service water, which is metered separately by a Fisher & Porter 150 mm dia. magnetic flow meter installed in a 200 mm dia. pipe, is taken off the east and west treated water discharge headers before the treated water flow meters. In addition, filter backwash water, which is taken directly from the treated water pump well, is not included in the treated water flow pumped to the distribution system. Filter backwash water is metered separately by a 600 mm dia. Venturi tube differential pressure flow meter.

A record of the total water produced is available from flow measurements of the filter effluent. Each of the four filter discharge pipes is equipped with a 400 mm dia. Venturi tube differential pressure flow meter.

Daily treated water flows pumped to the distribution system are tabulated in Table 1.1 for 1984 to 1986. These flows appear consistent for the entire record and no significant anomalies could be identified. Again, minimum daily flows generally occurred on Sundays and/or on a

Statutory Holiday. There are several occasions when the minimum daily flow occurred on Saturday.

A monthly summary of daily average, minimum and maximum flows is given for each year at the end of Table 1.1. This summary is of interest as it shows a higher average day water demand existed in 1984 than in 1985 or even 1986. Further, the maximum yearly average day in 1984 occurred in April and followed high average day flows for January, February and March as well. Pumpage during May, June and July was lower but comparable to values for the same months in 1985 and 1986. August and September flows in 1984 however, returned to the higher values that are typical of the summer season. Unfortunately, the validity of the flow data cannot be established solely on the basis of the available record.

The apparent declining water consumption will be evident from the yearly flow summary given below:

Yearly Summary of Treated Water Flows, ML/d

	1986	1985	1984
Average Day	19.94	19.98	23.54
Maximum Day	30.74 (Jun.)	32.15 (Jan.)	35.64 (Aug.)
Minimum Day	10.80 (Feb.)	10.71 (Nov.)	8.80 (July)

c) Monthly Summary of Raw and Treated Water Flows

A monthly summary of raw and treated water flows for the last three consecutive years is presented in Table 1.0. This table tabulates monthly daily averages, as well as daily maximum and minimum flows in ML/d.

In assessing the validity of these flow records, we have compared raw water flows with treated water flows adjusted by 2 percent to account for service water and filter backwash water consumption. On this basis, Table B.2 following, was prepared to show the imbalance in pumping rates for monthly average day flow records.

It is noted that the plant reservoir has a variable storage capacity of some 4100 ML. Since raw water pumps are selected manually based on settled water conduit level and treated water pumps are selected manually based on level in the Centennial Avenue Reservoir, it is possible for pumping rates (raw and treated water) to be somewhat out of phase - the imbalance being levelled out by the capacity of the treated water reservoir. However, the imbalance cannot exceed the capacity of the reservoir; hence in analyzing the data in Table B.2 reservoir storage capacity is insignificant and has been neglected.

With reference to Table B.2, it is evident that raw water flow meters during 1986 read higher than treated water flow meters on the average by 19.6%. During the first two months of 1985 treated water flow meters recorded higher readings but thereafter, for the remainder of the year, raw water meters read higher. Over the entire year of 1985, the average imbalance in metered flow rates was 17.6 percent in favour of the raw water meters. Data for 1984 are less consistent. During the first four months of the year treated water meter readings were higher; for the next four months, raw water meter readings were higher. For each period, the imbalance was large enough to exceed available reservoir storage capacity. The imbalance for the last four months of 1984 was small enough to be absorbed by reservoir storage capacity.

The analysis above shows that:

1) raw water, treated water or both raw and treated water flow meters are inaccurate, or
2) a problem exists in totalizer conversion from Imperial units to metric units, or
3) the imbalance in raw and treated water pumping rates is due to a combination of items 1) and 2) above.

TABLE B.2

IMBALANCE IN PUMPING RATES

RAW WATER VERSUS TREATED WATER, ML/d

	1986	1985	1984
January	+6.014	-0.814	-3.656
February	+5.675	-0.169	-3.483
March	+5.286	+4.331	-3.626
April	+4.740	+5.244	-5.765
May	+5.019	+4.522	+1.183
June	+5.295	+4.622	+2.984
July	+4.367	+4.690	+2.328
August	+2.513	+5.210	+0.431
September	+3.172	+5.149	-0.026
October	+4.991	+5.994	+0.138
November	+5.52	+6.944	-0.531
December	+5.22	+6.501	-0.207
Monthly Average	+4.813	+4.352	-0.853
Total Imbalance for Year, ML	+1758	+1588	-311
Recorded Yearly Production, ML	8952.5	9030.1	8453.4
Percent Imbalance Compared to Raw Water Pumped, %	+19.6	+17.6	-3.7

NOTES: + raw water exceeds treated water flow

- raw water flow is less than treated water flow

B.3 PER CAPITA WATER CONSUMPTION

Insufficient population data are available in order to establish monthly per capita flows for the three years under examination. Only one population figure for each service area was available from the plant which relates to August 3, 1983. In addition, flows for individual service areas, although available, have not been tabulated since they are not needed for the purpose of the optimization study.

A gross per capita consumption value could be calculated based on treated water pumped to the distribution system. Such a value, however, would not be very meaningful since it does not accurately reflect actual consumption because of:

1) imbalance resulting from distribution system storage
2) large industrial, single user demand of the Ford Motor Company and
3) the wide variation in residential consumption between St.Thomas and the rural-type villages.

The per capita flows determined in Table B.3 following will serve to illustrate the above argument. For instance, the per capita flow for January 1984 based on total pumpage to St. Thomas, was 848 Lpcd. This compares with a net figure for St.Thomas, based on billed water consumption (Table B.3, Item 7) of 470 Lpcd. Gross per capita water demands which include the industrial consumption by the Ford Motor Company are less meaningful and not suitable for evaluation.

The net per capita flows for St.Thomas, Port Burwell and Vienna (Table B.3, Item 7) compare favourably with recommended design values of 270 to 450 Lpcd. Values appear consistent with records for other similar service areas; although, those for Port Burwell and Vienna, two small rural-type communities, are somewhat low due to possible inaccuracies in population figures. Albeit, data shown are for January when consumption typically is low.

Representative per capita water consumption records (1981 data) for several communities in Ontario are as follows:

Communty	Population Served	Per Capita Consumption (Lpcd)
Ajax	23 281	456
Alvinston	420	333
Ancaster	11 000	198
Barrie	34 000	584
Blenheim Twp.	3 999	566
Bradford	4 170	152
Bolton	6 600	189
Caledon East	1 200	151
Cambridge	70 000	539
Chatham	39 494	473
Woodstock	26 020	735
Newmarket	21 000	387

TABLE B.3

ST. THOMAS - ELGIN AREA

PER CAPITA WATER CONSUMPTION

Service Area	Population (Aug.1983)	Avg.Day Flow, m^3/d (Jan. 1984)	Per Capita Flow (Lpcd)
1) St. Thomas	28 734	16 228	565
2) Ford Motor Company	486	6 678	13 741
3) Port Burwell (total)	1 707	410	240
4) St.Thomas Pipeline (1)	29 322	24 876	848
5) Total Plant Discharge (2)	30 927	25 286	818
6) Total Plant Discharge Less Supply to Ford M.C.	30 927	18 608	602
7) Consumption as Billed:			
. St. Thomas	28 734	13 515	470
. Port Burwell	1 005	186.9	186
. Vienna	390	59.8	153

NOTES: (1) incl. St.Thomas, Yarmouth Twp., Ford M.C. and Talbotville
(2) incl. all flows pumped to St.Thomas and Port Burwell

SECTION C

PROCESS COMPONENTS

SECTION C - PROCESS COMPONENTS

C.1 GENERAL

The St. Thomas (Elgin Area) Water Treatment Plant, constructed from 1966 to 1968, was designed for an initial capacity of 45,460 m^3/d with an ultimate capacity of 90,920 m^3/d. Provisions were made for future expansion of the plant up to 181,840 m^3/d maximum hydraulic flow.

The Block Flow Diagram in Figure C.1 illustrates the treatment facilities that are provided.

The plant design uses the conventional treatment process consisting of rapid mixing, two-stage flocculation, sedimentation and gravity, high rate, dual-media filtration. Raw water is drawn through a 1524 mm dia. intake to a low lift pumping station located on the shore of Lake Erie. The station has a unique circular design and includes travelling raw water screens, vertical turbine pumps, and a drain well for receiving and conveying treatment plant wastes back to the lake.

Water is pumped from the low lift pumping station through a 900 mm dia. concrete pressure main to the treatment plant which is located some 1.4 km to the north on Elgin County Road No. 24. At the plant (in Chemical Building) flow splits into two 400 mm dia. supply pipes feeding each of the two pretreatment modules (rapid mix, flocculation and sedimentation tanks).

Following pretreatment, the water is filtered in four dual-media, gravity filters. These are rectangular in design and include a wash water gullet along the longitudinal side of the filter. Filters are enclosed by the Filter Building which contains the filter operating gallery and pipe gallery below, at the head of the filters. The filtered water conduit and partially the clear well are located below the filters. Treated water overflows the clear well to the reservoir from where it flows via the high lift suction conduit to the high lift pump wells.

chemical treatment is provided in the form of:

- pre-chlorination of the raw water
- alum coagulation to aid clarification and filtration
- powdered activated carbon treatment for the control of taste and odour
- chlorination of the settled water
- post-chlorination for disinfection and protection of the water against possible re-contamination by bacteria in the distribution system
- fluoridation for the control of dental caries.

The high lift pumping station, combined with the Administration Building, includes four treated water pumps and two filter backwash water pumps, all of the vertical turbine, centrifugal pump design. Treated water is pumped to distribution via the east and west pipe headers which serve Elgin Area townships and villages, the City of St. Thomas, and the Ford Motor Company at Talbotville.

C.2 DESIGN DATA

A summary of the design data and relevant plant information is presented in Table C.1. The Process Design Schematic in Figure C.2 illustrates the relationship of process components and provides a convenient overview of the sizing and capacities of these components.

a) Capacity

The plant was designed for an initial capacity of 45,460 m^3/d. The ultimate design capacity is 90,920 m^3/d which can be achieved by upgrading pumping equipment and the installation of a second rapid mixer in each of the two tanks. Provisions have been made for future expansions of the plant to an ultimate maximum flow of 181,840 m^3/d.

The maximum average day raw water flow treated at the plant to the end of 1986 was 38,090 m^3/d.

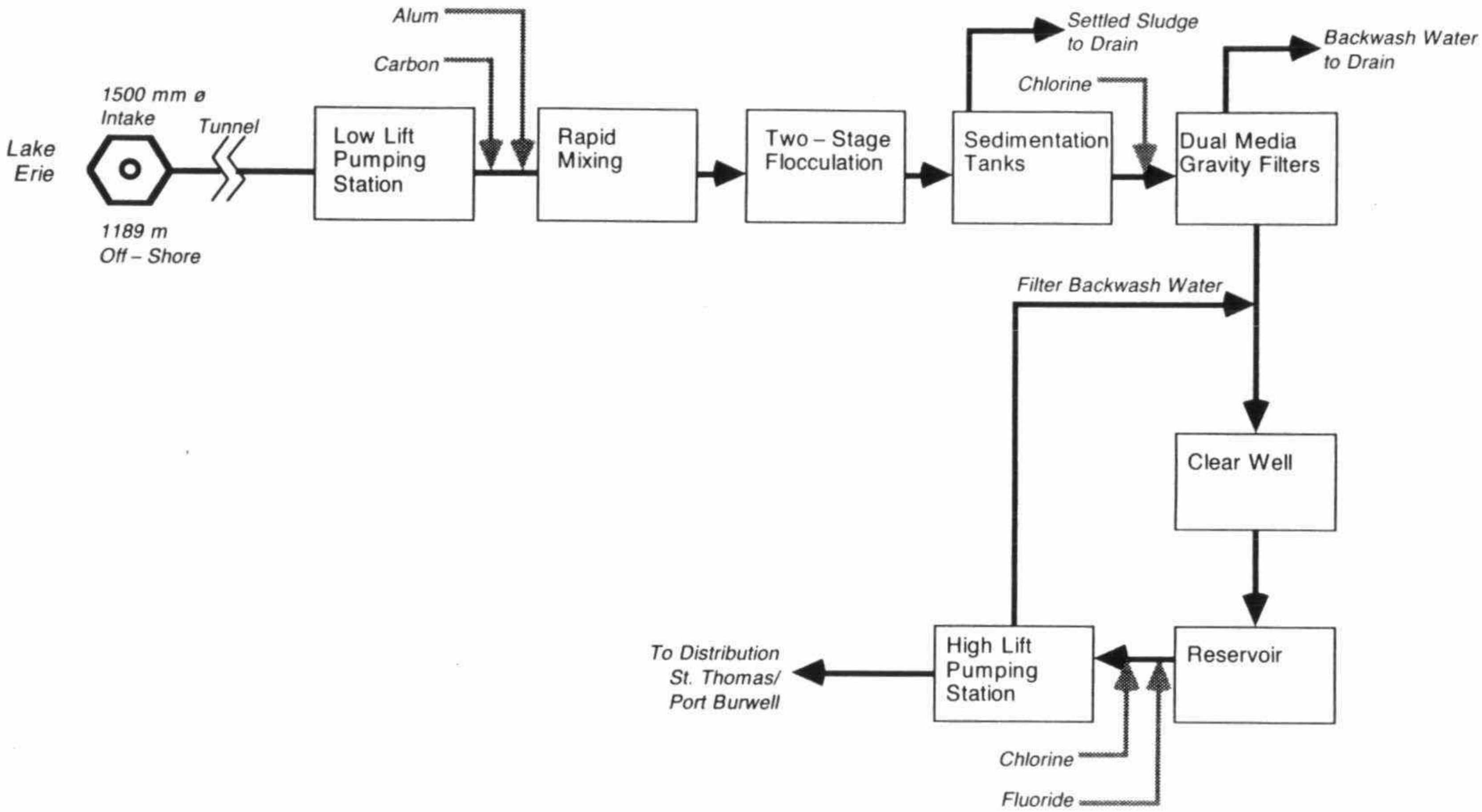

Figure C.1
ST. THOMAS WATER TREATMENT PLANT
Block Flow Diagram

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TABLE C.1

ST. THOMAS (ELGIN AREA) WATER TREATMENT PLANT

DESIGN DATA AND PLANT INFORMATION

PLANT ADDRESS

Municipality	Elgin Area Water System owned and operated by the Ontario Ministry of the Environment
Plant Name	St. Thomas (Elgin Area) Water Treatment Plant
Plant Address	P.O. Box 514 St. Thomas, Ontario N5P 3V6
Phone Number	(519) 782-3101

YEAR PLANT OPENED

1968 (built in 1966 to 1968)

WATER SOURCE

Lake Erie

PLANT CAPACITY

Design Capacity	45,460 m^3/d
Ultimate Capacity	90,920 m^3/d
Ultimate Max. Flow	181,840 m^3/d

INTAKE

Crib	- fabricated steel, octagnonal-shaped intake crib, - 9.2 m water depth based on average lake level of 174 m - crib submergence at avr. lake level is about 6.7 m
Intake Pipe	- 1524 mm dia. by 1189 m offshore, reinforced concrete pressure pipe, laid in trench on lake bottom

INTAKE (cont'd)

• Capacity	- 2.105 m^3/s @ 1.07 m max. drawdown
	- volume of intake is about 2,170 m^3
• Surge Well	- 9.60 m W x 3.66 m L x 10.1 m D, volume 350 m^3

LOW LIFT PUMPING STATION

Travelling Screens	- 2 - 1.5 m W x 10 m H installed, 1 future
Pumps	- 4 installed
• Type	- vertical turbine driven by electric induction motors
• Capacity	- 3 @ 210.5 L/s @ 82.3 m TH; motor - 186.5 kW
	- 1 @ 105.2 L/s @ 82.3 m TH; motor - 111.9 KW
• Discharge Pipe	- 3 @ 300 mm dia. increasing to 500 mm dia.
	- 1 @ 200 mm dia. increasing to 500 mm dia.
	- 1 - 900 mm dia. common discharge pipe to treatment plant

RAPID MIXING

No. of Units	- 2 tanks, 1 per pretreatment module, 2 cells per tank
Dimensions per Cell	- 2.44 m W x 2.44 m L x 3.66 m D; 3.14 m SWD @ design flow
Volume	- 18.7 m^3 per cell; 42 m^3 per tank
Detention Time	- 1.2 min. @ design flow
Vertical Turbine Mixer	
• Number	- 1 per tank installed, 1 per tank future
• Motor Rating	- 3.73 kW
• G Value	- 350 s^{-1}
• Gt Value	- 25,200 design

FLOCCULATION

No. of Units	- 2 tanks, 4 cells per tank - 2 primary and 2 secondary cells
Dimensions per Cell	- 7.85 m W x 6.10 m L x 4.57 m D, 3.33 m SWD, each cell @ design flow

FLOCCULATION (cont'd)

Volume	- 159.5 m^3 per cell, 638.0 m^3 per tank
Detention Time	- 40.4 min. design
Flocculators	
• Primary Cells	- vertical turbine flocculators, 1 per cell
· Motor Rating	- 2.24 kW each
· G Value	- 80 s^{-1}
· Gt Value	- 48,500
• Secondary Cells	- vertical turbine flocculators, 1 per cell
· Motor Rating	- 1.12 kW each
· G Value	- 40 s^{-1}
· Gt Value	- 24,250

SEDIMENTATION

• No. of Tanks	- 2 tanks, equipped with 3 sets of bottom rails for future chain and flight sludge collectors
• Dimensions per Tank	- 16.0 m W x 60.3 m L x 4.1 m D, 3.2 m SWD @ design flow
• Volume	- 3090 m^3 per tank
• Detention Time	- 3.3 h design
• Surface Overflow Rate	- 0.98 m/h design
• Outlet	- 5 - ports 0.457 m W x 0.457 m H, A = 0.209 m^2 per port or 1.045 m^2 total
• Settled Water Conduit	- 1.12 m W x 1.73 m D, 0.84 m SWD @ design flow

FILTRATION

Number of Filters	- 4, rectangular bays with side wash water gullet
Type	- dual media (anthracite and sand), high rate, gravity fitters
Size	- 6.10 m W x 15.88 m L x 4.27 m D trough elevated 2.74 m above floor, 3.05 m SWD @ design flow
Surface Area	- 97 m^2 per filter, 388 m^2 total
Filter Rate	- 4.89 m/h design
Detention Time	- 27 min. design

FILTRATION (cont'd)

Media	
• Anthracite	- 457 mm, E.S. = 0.84 to 1.00 mm, U.C. < 1.72
• Sand	- 305 mm, E.S. = 0.52 to 0.58 mm, U.C. = 1.54 to 1.73
• Gravel	- 330 mm graded, 50 mm to 1.2 mm, 5 layers
Underdrains	- Miller Block, 250 mm deep
Surface Wash	- Rotary, straight arm, 3 per filter, 5.03 m dia. each
Wash Water Rate	- 450 mm rise per minute low, 900 mm rise per minute high (54 m/h)

CLEAR WELL

Size-Filtered Water Conduit	- 3.66 m W x 49.5 m L x 3.96 m D, 3.45 m SWD @ design flow
-Clear Well	- 29.0 m W x 26.7 m L x 3.96 m D, 3.45 m SWD @ design flow
Volume	- 3,300 m^3, fixed storage
Detention Time	- 104 min. design

RESERVOIR

Size-Reservior	- 33.2 m W x 36.7 m L x 3.96 m D, 3.45 m max. SWD (variable)
	- 3.66 m W x 10.2 m L x 5.26 m D, 4.9 m max. SWD
-Suction Conduit	- 8.08 m W x 15.5 m L x 5.49 m D, 4.98 m max SWD
	- 3.66 m W x 16.3 m L x 5.49 m D, 4.98 m max. SWD
Volume	- 4,200 m^3 Reservoir, 1,100 m^3 Suction Conduits, 5,300 m^3 total, variable storage
Detention Time	- 167 min. design max.

HIGH LIFT PUMPING STATION

High Lift Pumps	
• Type	- vertical turbine, centrifugal pumps, driven by electric induction motors
• Number of Pumps	- 4 total, future - change pumps
• Capacity	- 3 @ 210.5 L/s @ 65.5 m TH, motor rating = 186.5 kW
	- 1 @ 105.2 L/s = 65.5 m TH, motor rating = 93.3 kW
	- 45,400 m^3/d firm capacity
• Wet Well	- 2 wells, 7.3 m W x 10.5 m L x 5.2 m SWD (max.), 398.6 m^3 8.1 m W x 10.5 m L x 5.2 m SWD (max.), 442.3 m^3, 840.9 m^3 total

HIGH LIFT PUMPING STATION (cont'd)

Filter Backwash Pumps

• Type	- vertical turbine, centrifugal pumps, driven by induction motors
• Number	- 2 total
• Capacity	- 2 @ 736.6 L/s @ 15.2 m TH, motor rating = 149.2 kW

CHEMICAL PROCESSES

Chlorination

• Prechlorination	- 2 application points: 1) in 760 mm dia. Raw water intake via pipe diffuser located in Valve Chamber No. 4 outside chemical building; 2) open channel diffusers (5 per settling tank) in settled water conduit (primary application points)
• Postchlorination	- 2 application points: 1) open channel diffuser in filtered water conduit; 2) open channel diffuser in high lift suction conduit after reservoir (primary application point)
• Storage	- 18-ton chlorine containers, 15 in inventory, 3 on scale - 1-3 ton container scale, dial cabinet with circular dial, recorder and low weight alarm signal transmitter
• Chlorine Feeders	- 3 chlorinators, W&T A-711, 1 - prechlorination, 1 - postchlorination, 1 - mechanical standby, 1 future
· Capacity	- 908 kg/d capability, 68 kg/d rotameter capacity

Fluoridation

• Chemical Applied	- sodium silicofluoride (Na_2SiF_6) in high lift suction conduit (after reservoir)
• Storage	- 45 kg bags, one bulk storage tank and one mobile dispensing cart
• Feeder	- Omega oscillating hopper-type, dry gravimetric feeder with solution tank, and proportional-to-flow controls

CHEMICAL PROCESSES (cont'd)

Coagulation	
• Chemical Applied	- liquid alum ($Al_2(SO_4)_3 \cdot 14\ H_2O$) is applied at the rapid mixers
• Storage	- 2 - 18.9 m^3 bulk FRP storage tanks, 3.05 m dia. x 2.74 m H
• Solution Pumps	- 2 - 1.89 L/s transfer pumps, 9.1 m TH, 1.12 kW motor
• Metering	- 1 - 1,200 L solution FRP day tank, 1.22 m dia. x 1.07 m H - 2 - Rotodip, dipper wheel-type feeders, 114 L/min. capability, 1.5 L/min. max. rate, service water added via rotameter in dilution tank downstream of feeder
Taste and Odour Control	
• Chemical Applied	- powdered activated carbon in slurry form at the rapid mixers
• Storage	- 2 - 27.3 m^3 bulk (concrete) storage tanks, 6.10 m W x 6.10 m L x 4.78 m D, 4.57 m SWD
• Solution Pumps	- 2 - 1.89 L/s transfer pumps, 7.62 m TH, 1.12 kW motor
• Metering	- 1 - 2,000 L slurry FRP day tank, 1.37 m dia. x 1.37 m H, day tank equipped with Lightnin NDLG-33 mixer, 0.25 kW motor - 2 - Rotodip, dipper wheel-type feeders, 114 L/min. capability, 4.17 L/min. max. rate, flow rate monitored via indirect reading rotameters on feed lines ahead of rapid mixers
On-Line Monitors	
• Turbidity	- 2 on-line turbidity meters, Hach Surface Scatter Turbidimeters, monitor raw and filtered water, local indication and signal transmission to recorder on main control panel
• Chlorine Residual	- 1 - automatic chlorine residual analyzer measuring total chlorine residual in treated water, local indication and circular chart recorder with signal transmisison to main control panel

b) Capacity Limitations

The present design capacity of 45,460 m^3/d is not limited by equipment or process components. Neither has there been any impact on capacity of the plant due to seasonal high raw water turbidities nor the presence of algae during the summer months.

C.3 PROCESS COMPONENT INVENTORY

a) Intake

The intake consists of a 1524 mm dia. reinforced concrete pressure pipe constructed in a trench below the lake bed.

The crib is octagonal in shape, is fabricated of steel, and is enclosed by a wooden screen with 75 mm wide openings. It is located 1189 m off-shore in 9.2 m of water. At average lake water level of 174 m, the crib is submerged by about 6.7 m.

The intake has a capacity of 2.105 m^3/s (181,900 m^3/d) at a maximum drawdown of about 1.07 m. The volume of the intake is about 2,170 m^3.

A surge well on the intake, located inside the Low Lift Pumping Station, has a volume of about 350 m^3.

No problems have been experienced with the operation of the intake. It can be back flushed, if necessary, by a 300 mm dia. branch header from the pump discharge.

b) Raw Water Screens

Two travelling raw water screens are installed each measuring 1.5 m wide by 10 m high. Space is available for the installation of one future screen. Screens are of the continuous belt, flow-through type and have a type 304 stainless steel wire mesh (2.7 mm dia.) with 9.5 mm clear openings. Other parts of the screen are made of rigid steel.

Screen operation is manual by push-button controls. Automatic controls are available which function to start operation based on differential head in the screen channel and sustain operation until shut-down by a pre-set timer. An alarm will sound at 50 and 100 mm water column differential.

Screens are only operated for 10 to 15 minutes per week. Cleaning is automatic during the operation of the screen by a spray water system. Wastes are discharged to the drain.

c) Low Lift Pumping

The Low Lift Pumping Station is designed for vertical turbine, centrifugal pumps. Two pump wells are available with two pump bays in each, which are currently occupied with pumping units as described in Table C.2. Larger capacity pumps will need to be installed to increase station capacity in the future. Individual pump discharge headers connect to a Y-shaped manifold and pipeline (760 mm dia.) to the treatment plant. At the plant the supply header splits into 2-400 mm dia. branch headers which connect to the rapid mix tank at each pretreatment module. Flow control to each module is remote manual by opening or closing respective inlet valves.

Raw water pumps are operated manually from the plant main control panel, but instrumentation exists for automatic control. In the manual mode raw water pumps are selected based on level in the settled water conduit - obtained from the level indicator. Shut-down is manual following a high level alarm. If there is no operator response, pumps will shut-down automatically.

Local controls are available on the main low lift pump control panel and at individual pump start/stop pushbutton stations.

The installed low lift station capacity is 63,650 m^3/d. With the largest pump out-of-service, the firm pumping capacity is 45,460 m^3/d. In case of power failure all pumps shut down.

TABLE C.2

RAW WATER PUMPS

Pump No.	Rated Capacity Flow L/s	Rated Capacity Head m	Type	Motor Rating kW	Manufacturer Pump/Motor
1, 2 & 3	210.5	82.3	vertical, centrifugal	186.5	Johnston Pump Canadian General Electric
4	105.2	82.3	vertical, centrifugal	111.9	Johnston Pump Canadian General Electric

Notes:

Installed Capacity: 63,650 m^3/d

Firm Capacity: 45,460 m^3/d

Standby power generation capacity is available at the plant for maintaining instrumentation and control equipment and for emergency lighting.

d) Rapid Mixing

Pretreatment units are arranged in two parallel modules (tanks), each including rapid mixing, flocculation and sedimentation basins. The flow range for each module is:

- minimum: 2,300 m^3/d
- average: 22,730 m^3/d (present capacity)
- maximum: 45,460 m^3/d (design capacity).

The rapid mix tank is divided into two chambers for series flow. Each chamber measures 2.44 m by 2.44 m by 3.66 m high. For a side water depth (SWD) of 3.14 m at design flow, the resulting volume per chamber is 18.7 m^3 or 42 m^3 per tank (incl. space between cells) and the detention time is 1.2 minutes (for the actively mixed cell with a volume of 18.7 m^3).

A vertical, flat-blade, turbine mixer is installed in cell 1. Space has been provided for the future installation of a second unit in cell 2. The motor has a rated capacity of 3.73 kW and operates at 1750 rpm. The mixer shaft speed is 68 rpm.

Process design parameters vary with plant flow as is illustrated in Table C.3 following. The minimum flow shown represents the average minimum flow rate for December of 1986. Average and maximum yearly flow rates are represented by the present and plant design capacity flow rates.

Coagulated water discharges from cell 2 through a 1.98 m wide full height opening into the distribution conduit which conveys water to cells 1 and 2 of the flocculation tanks. The water is introduced at mid-depth through six inlet ports, three per cell. The conduit measures 1.22 m wide by 1.83 m high and each port is 0.38 m wide by 0.38 m high.

e) Flocculation

Each of the two flocculation tanks is divided into two primary cells and two secondary cells for two stage tapered mechanical flocculation.

All cells are equal in size and measure 7.85 m W x 6.10 m L x 4.57 m D. The side water depth at the design flow rate is 3.33 m and the resulting volume per cell is 159.5 m^3 or 638.0 m^3 per tank.

Each cell is equipped with a vertical turbine, axial-flow mixer. Those in primary cells are of high rate capacity and those in secondary cells have moderate mixing capacity. Motor ratings and process design parameters are presented in Table C.4. Mixers achieve velocity gradients of 80 s^{-1} in primary cells and 40 s^{-1} in secondary cells. The detention time is variable and ranges from 67.4 minutes to 23.8 minutes for minimum and maximum (ultimate) flows. At the design flow rate the detention time is 40.4 minutes and the Gt product is 145,500.

The flocculation tank inlet port velocities are:

Plant Flow, m^3/d	Inlet Velocity, m/s
45,460 - design	0.30 (2 tanks in service)
90,920 - ultimate	0.60 (2 tanks in service)

Flocculation tank outlet is at high level and consists of a broad-crested overflow weir extending across the entire length of each cell.

f) Sedimentation

Sedimentation tanks, one for each of the two pretreatment modules, each measure 16.0 m wide by 60.3 m long by 4.1 m deep and have an operating side water depth of 3.2 m at the design flow rate. The tank volume is 3,090 m^3 and the resultant detention times and overflow rates for the various plant flows are as follows:

TABLE C.3

RAPID MIXING PROCESS DESIGN

Plant Flow, m^3/d	Detention Time, min.	G Value, s^{-1}	Gt Product
13,630 - minimum (1)	2.0	350	42,000
45,460 - design (2)	1.2	350	25,200
90,920 - ultimate (3)	1.2	350	25,200

(1) 1 tank, 1 cell in service
(2) 2 tanks, 1 cell in service
(3) 2 tanks, 2 cells in service

TABLE C.4

FLOCCULATION PROCESS DESIGN

A. FLOCCULATOR SPECIFICATION

Floc Basin	Mixer	Motor Rating, kW	Mixer Speed, rpm	G Value s^{-1}
Tank 1 & 2				
· Primary Cells 1 & 2	4-vertical turbine, -1.27 m impeller dia.	2.24	50	80
· Secondary Cells 3 & 4	4-vertical turbine, -0.914 m impeller dia.	1.12	63	40

B. PROCESS DESIGN

Plant Flow m^3/d	Detention Time, min. Primary Cell Secondary Cell Total	Gt Product Primary Cell Secondary Cell Total
13,630 - minimum (1)	33.7	162,000
	33.7	81,000
	67.4	243,000
45,460 - design (2)	20.2	97,000
	20.2	48,500
	40.4	145,500
90,920 - ultimate (2)	11.9	57,100
	11.9	28,600
	23.8	85,700

(1) 1 tank in service
(2) 2 tanks in service

Plant Flow, m^3/d	Detention Time, h	Surface Overflow Rate, m/h
13,630 - minimum (1)	5.44	0.59
45,460 - design (2)	3.26	0.98
90,920 - ultimate (2)	1.91	1.96

(1) 1 tank in service
(2) 2 tanks in service

Sedimentation tank inlet weir velocities are 0.055 m/s.m and 0.037 m/s.m for the design and ultimate flow rates.

The sedimentation tank outlet consists of five ports, each measuring 0.457 m wide by 0.457 m high. The port invert elevation is about 0.46 m below the top water level at the design flow rate. The effluent discharges into the settled water conduit which transfers water to the filters. The dimensions of the conduit are 1.118 m wide by 1.727 m high. At the design flow rate the operating water level in the conduit is about 0.76 m.

Sedimentation tanks are manually cleaned. Bottom rails have been provided for the future installation of flight and chain-type sludge collecting mechanisms.

g) Filters

The plant has four dual-media, gravity filters located in the Filter Building. They are rectangular in shape and include one wash water gullet along one longitudinal side of each filter. Spacious pipe and filter operating galleries extend across the front of the filters. Filters operate on the principle of constant rate filtration.

Filter bays measure 7.62 m wide by 15.88 m long by 4.27 m deep. The wash water gullet is 1.22 m wide and the filter is 6.10 m wide. The wash water trough weir elevation is 2.74 m above the floor of the box.

The operating water depth at the design flow is 3.05 m above the floor and the detention time (based on a media porosity factor of 0.45) is 27 minutes.

Each filter has a surface area of 97 m^2 and the total area for four filters is 388 m^2.

The 250 mm deep Miller Block underdrains are covered with five layers of graded gravel ranging in size from 50 mm to 1.2 mm with a total depth of 330 mm. The filter media consists of a layer of sand and anthracite with the following characteristics:

Media	Depth, mm	E.S., mm	U.C.
anthracite	460	0.84 to 1.00	<1.72
sand	300	0.52 to 0.58	1.54 to 1.73

Filter valves and piping include:

- 600 mm dia. motorized butterfly inlet valve
- 900 mm dia. motorized butterfly main drain valve
- 600 mm dia. wash water pipe with motorized butterfly valve
- 400 mm dia. filter effluent with motorized butterfly rate control valve
- 150 to 200 mm dia. filter drain with manually operated gate valve.

Each filter effluent pipe includes a 400 mm dia. Venturi tube flow meter and flow transmitter.

Filters are equipped with three 5.03 m diameter rotary, straight arm, Palmer sweep surface agitators. Two backwash water pumps are available giving a maximum wash water rise rate of 900 mm per minute equivalent to 54 m/h.

Wash Water System

The High Lift Pumping Station includes two vertical centrifugal pumps by Johnston Pump Company, driven by electric induction motors manufactured by Cdn. General Electric. Pumps have a capacity of 736.6 L/s at a total head of 15.2 m. The motor rating is 149.2 kW.

Filter Instrumentation

Filter instrumentation equipment includes the following:

- individual filter consoles
- individual filter rate setting controllers
- filter effluent flow measurement with transmitter to main control panel and filter rate controllers
- high lift suction conduit level measurement and transmission to filter consoles and main control panel
- filter head loss measurement with signal transmission to filter control console and main control panel
- turbidity measurement in filter effluent with signal transmission to main control panel
- program for automatic backwashing of filters based on filter head loss
- controllers for all motorized valves and for starting and stopping the backwash pumps

h) Clear Well

Filtered water discharges to the filtered water conduit which measures 3.66 m wide by 49.5 m long by 3.96 m deep. The water then flows to the clear well which has dimensions of 29.0 m wide by 26.7 m long by 3.96 m deep. The side water depths in the conduit and well are 3.45 m and the combined fixed, storage capacity is 3,300 m^3.

The detention time at the design flow rate is 1.74 h.

i) Reservoir

A treated water reservoir has been provided measuring 33.2 m wide by 36.7 m long by 3.96 m deep. The water level is variable and depends upon rates of production and effluent pumping. The reservoir supplies water via the high lift suction conduit to the treated water pump wells. The suction conduit width varies from 3.66 m to 8.08 m and has a length of 42.0 m. At maximum level the side water depth is 3.45 m resulting in a combined total storage capacity of 5,300 m^3 and maximum retention time of 2.78 h at design flow.

j) High Lift Pumping

The High Lift Pumping Station is designed for four pumps of the vertical, centrifugal type. Two pumps wells have been provided, each of which includes two treated water pumps and one backwash water pump. Pump capacities and motor ratings for treated water pumps are tabulated in Table C.5.

The installed high lift station capacity is 63,650 m^3/d at a total head of 65.5 m. With the largest pump out of the service, the firm station capacity is 45,460 m^3/d. Future station capacity may be increased by changing pumps.

No standby power is available to run treated water pumps during an emergency power outage.

Two 600 mm diameter discharge headers, the east and west headers, convey treated water to Port Burwell and St. Thomas. Plant output is metered by a magnetic and ultrasonic flow meters.

Control of treated water pumps and their respective discharge valves is remote manual from the main control panel. Pumps are selected on the basis of the water level in the Centennial Avenue Reservoir.

TABLE C.5

TREATED WATER PUMPS

Pump No.	Rated Capacity Flow L/s	Head m	Type	Motor Rating kW	Manufacturer Pump Motor
1, 2 & 3	210.5	65.5	vertical, centrifugal	186.5	Johnston Pump Tamper Motors
4	105.2	65.5	vertical, centrifugal	93.3	Johnston Pump Tamper Motors

Notes:

Installed Capacity: 63,650 m^3/d

Firm Capacity: 45,460 m^3/d

Information on water levels in the distribution system reservoir and elevated tank is recorded at the treatment plant main control panel via telemetering equipment using telephone lines.

Surge relief for the common treated water discharge header is available in the form of two pressurized air tanks, 3.0 m diameter by 6.1 m long.

k) Backwash Treatment and Sludge Disposal

Filter backwash water is discharged directly to Lake Erie via a 900 mm diameter plant drain that extends 122 m into the lake.

Sedimentation tanks are desludged four times per year. The wash down is discharged to the plant drain.

l) Standby Power

Standby power is available from one diesel engine generator set rated 60 kW, 75 kVA, 0.8 p.f., 550 V, 3 phase. During a power outage, the generator will maintain instrumentation and emergency lighting facilities. Standby power for the operation of equipment and pumps is not required since sufficient storage is available in the distribution system and power failures are infrequent.

C.4 CHEMICAL SYSTEMS

C.4.1 LIQUID CHEMICAL FEED EQUIPMENT

a) Liquid Alum

The following equipment is available for storing and feeding liquid alum as a primary coagulent to the flash mixers:

- 2 - 18.9 m^3 bulk FRP storage tanks, 3.05 m dia. by 2.74 m high

- 2 - 1.89 L/s transfer pumps, 9.1 m total head, 1.12 kW motor, 1 for each tank
- 1 - 120 L solution FRP day tank, 1.22 m dia. by 1.07 m high
- 2 - Rotodip, dipper wheel-type feeders, 114 L/min. capability with 12:1 electric and 10:1 feeder turn-down ratios,
- capacity set at 1.5 L/min. max. rate - service water added via rotamater in dilution tank downstream of feeder.

Alum feeders are equipped with automatic proportional-to-flow controls; dosage adjustment is manual. The raw water flow signal from the respective plant module is used for pacing the alum dosage.

b) Powdered Activated Carbon

The plant has facilities for feeding powdered activated carbon slurry for the control of taste and odour.

The equipment available for storing and feeding powdered activated carbon is listed below:

- 2 - 27.3 m^3 bulk solution (concrete) storage tanks, 6.10 m W x 6.10 m L x 4.78 m H, 4.57 m SWD
- 2 - 1.89 L/s transfer pumps, 7.6 m total head, 1.12 kW motor
- 1 - 2,000 L slurry FRP day tank, 1.37 m dia. x 1.37 m H, equipped with Lightnin NDLG - 33 mixer, 0.25 kW motor
- 2 - Rotodip, dipper wheel-type feeders, 114 L/min. capability with 12:1 electric and 10:1 feeder turn-down ratios,
- capacity set at 4.7 L/min. max. feed rate.

Carbon feeders are equipped with automatic proportional-to-flow controls and are paced relative to raw water flow.

Carbon slurry is applied to the raw water at the flash mixers in the concentration of the bulk slurry. Indirect reading rotameters on the feed lines ahead of the flash mixers are used for monitoring flow rates.

c) Fluoride

Fluoride in the form of dry sodium silicofluoride is mixed in a dissolver tank after metering and added to the treated water via a diffuser located in the high lift pump suction conduit.

Storage and feed equipment include:

- 45 kg bags dumped into bulk storage tank
- 1 - mobile dispensing cart
- 1 - Omega oscillating hopper-type, dry gravimetric feeder with solution tank and proportional-to-flow controls.

The fluoride dosage is set by manually adjusting the loss of weight rate setter and paced automatically relative to summated treated water flow.

C.4.2 GASEOUS CHEMICAL FEED EQUIPMENT

Chlorine Gas

Chlorine gas in solution form is applied for prechlorination and postchlorination. Application points are:

- prechlorination:
  1) raw water intake via pipe diffuser located in Valve Chamber No. 4 outside Chemical Building
  2) settled water conduit (primary application point)
- postchlorination:
  1) filtered water conduit
  2) high lift suction conduit (primary application point).

Storage Equipment

- 18 - ton chlorine containers, 15 in inventory, 3 on scale
- 1 - three ton container weigh scale, dial cabinet with circular dial and low weight alarm signal transmitter.

Storage Equipment

- 18 - ton chlorine containers, 15 in inventory, 3 on scale
- 1 - three ton container weigh scale, dial cabinet with circular dial and low weight alarm signal transmitter.

Feeders

- 3 - 907 kg/d, W & T A-711, chlorinators, feed capacity 68 kg/d, complete with proportional-to-flow controls - one each for pre- and postchlorination service and one for mechanical standby.

Analyzer

- 1 - automatic chlorine residual analyzer, W & T, for monitoring total chlorine residual in treated water.

Chlorine analyzer instrumentation includes local indication and circular chart recording as well as signal transmission to the main control panel.

C.5 SAMPLING

Sample pumps are of the single stage peripheral turbine type, Aurora Series E4, installed to deliver continuously flowing water samples to the sample sink in the Plant Laboratory.

Four pumps are provided for sampling of raw water, flocculated water, settled water, and filtered or treated water. Pumps 1 and 2 are located in the Chemical Building, whereas pumps 3 and 4 are located in the filter pipe gallery.

Sample pump specifications and information on sampling points, piping sizes, flow velocities and travel times to the point of discharge are presented in Table C.6.

Pumps are constructed of cast iron casings and have cast bronze impellers. Sample pipes are made of Type K copper tubing and have soldered connections.

TABLE C.6

SAMPLE PUMPS

Location Sampling Service	Pump No.	Sampling Point	Pump Capacity, L/s	Total Head, m	Motor Rating, kW	Suct./Disch. Piping, mm	Pipe Length, m	Travel[1] Time, min.
Chemical Building								
- Raw Water Inlet	1	#1	0.379	30.5	0.746	25/19	145	2.03
- Floc Tank Outlet	2	#2-North	0.379	30.5	0.746	25/19	106	1.44
		#2-South				25/19	128	1.93
Filter Building								
- Settled Water Conduit	3	#3-South	0.379	30.5	0.746	25/19	52	0.81
		#4-North				25/19	46	0.68
- Reservoir Inlet		#6				25/19	134	2.63
- Filtered Water Conduit	4	#5	0.379	30.5	0.746	25/19	62	1.04
- High Lift Suction Conduit		#7				25/19	74	1.30
- Reservoir Inlet		#6					46	2.63
- Treated Water Discharge Header		#8-East				-/19	40	0.33
		#8-West				-/19	28	0.23

(1) Pipe flow velocities for all sample pump lines are:
- Suction: 0.75 m/s
- Discharge: 1.34 m/s

Pipe velocity for Sample Point #8 is about 2.0 m/s.

C.6 PROCESS AUTOMATION

Instrumentation has been provided for automatic or manual operation of the water treatment plant and pumping equipment. Automatic control equipment consists of analogue instrumentation which, for the most part, is no longer used. Plant operations, therefore, are essentially manual.

A listing of the instrumentation and control equipment available at the plant is as follows:

Low Lift Pumping Station

- surge well level with high and low level alarms
- surge well water temperature measurement
- screen channel differential measurement
- pump well level indication and alarms
- travelling water screen control panel
- low lift pump local control panels
- low lift pump control panel including telemetering equipment for data transmission to master control panel at the water treatment plant.

Treatment Section

- raw water flow measurement
- raw water turbidity measurement
- settled water conduit water level measurement and high/low level alarm
- settled water conduit level control function
- filter rate measurement
- filter rate control function
- individual filter consoles
- filter analogue controller, one for each filter
- filter loss of head measurement
- filter effluent turbidity measurement
- automatic filter backwash program

- wash water flow measurement
- high lift suction conduit level measurement.

Chemical Systems

- liquid chemical feeder control panels
- proportional-to-flow controllers
- chlorine gas instrument panel
- gas detector
- annunciator for low pressure, low weight, high/low chlorine residual, free chlorine gas in air
- residual chlorine analyzer.

Treated Water Pumping Station

- treater water discharge flow measurement
- treated water pressure measurement
- treater water pump control
- wash water pump control
- treated water pump local control panels
- wash water pump local control panels
- plant main control panel.

C.7 EMERGENCY STANDBY OPERATION

In the event of a power failure all plant operations are shut down. Instrumentation and emergency lighting is maintained by power from one electric diesel generator rated at 60 kW.

C.8 DRAWINGS

a) Plant Drawings

Included in this report are two drawings:

1) Dwg. No. G1 of 3, Project No. OWRC-WP-65-2 - General-Site and Location Plans
2) Dwg. No. E14 of 21, Project No. OWRC-WP-65-2 - Electrical-Instrumentation Schematics.

A mechanical process and piping diagram is not available in the contract drawings and the instrumentation and control schematic has been included as an alternate.

b) Process Design Schematic

Figure C.2 presents a process design schematic of the St. Thomas (Elgin Area) Water Treatment Plant.

c) Pictures

A photographic record is included in this report following Figure C.2. The record is preceded by a photograph index.

PHOTOGRAPHIC RECORD

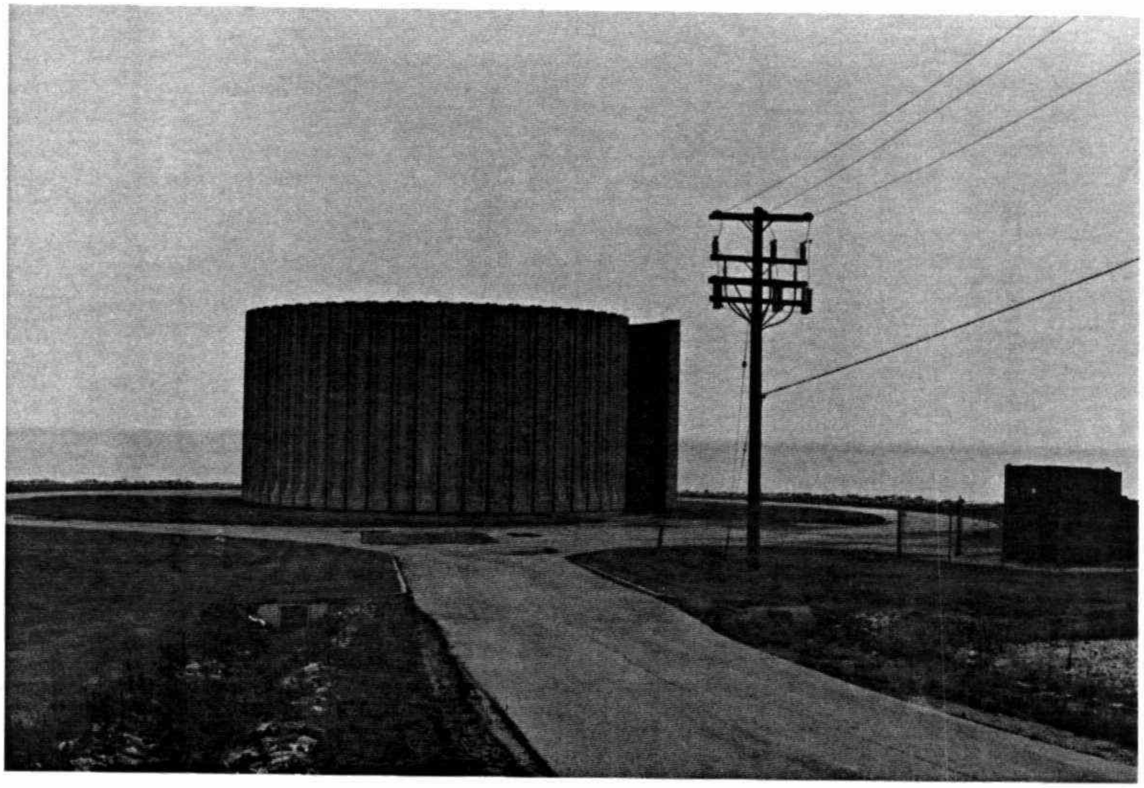
St. Thomas W.T.P. - Photograph Index

Photograph	Subject
1	Water Treatment Plant - Front Elevation
2	Chlorination Building - Front Elevation
3	Low Lift Pumping Station
4	Travelling Water Screens
5	Low Lift Pumps and Discharge Piping
6	Low Lift Pump
7	Chlorine Weigh scale
8	Chlorinators, Chlorine Analyzer, and Chlorine Control Panel
9	Raw Water Pipe Gallery - Flow and Turbidity Metering Instrumentation
10	Alum Storage Tanks and Transfer Pumps
11	Carbon Slurry Mixer
12	Carbon Slurry Transfer Pumps
13	Carbon Slurry and Alum Day Tanks
14	Vertical Turbine Rapid Mixers
15	Rotodip Alum Feeders
16	Rotodip Carbon Slurry Feeders
17	Flocculation Tank
18	Vertical Turbine Flocculator
29	Upper Filter Pipe Gallery - Filter Inlet and Washwater Drain Piping
20	Lower Filter Pipe Gallery - Filter Effluent and Washwater Piping
21	Filter Control Gallery
22	Filter Control Console
23	Gravity Filters
24	High Lift Pumping Station - Two High Lift and One Filter Backwash Pump

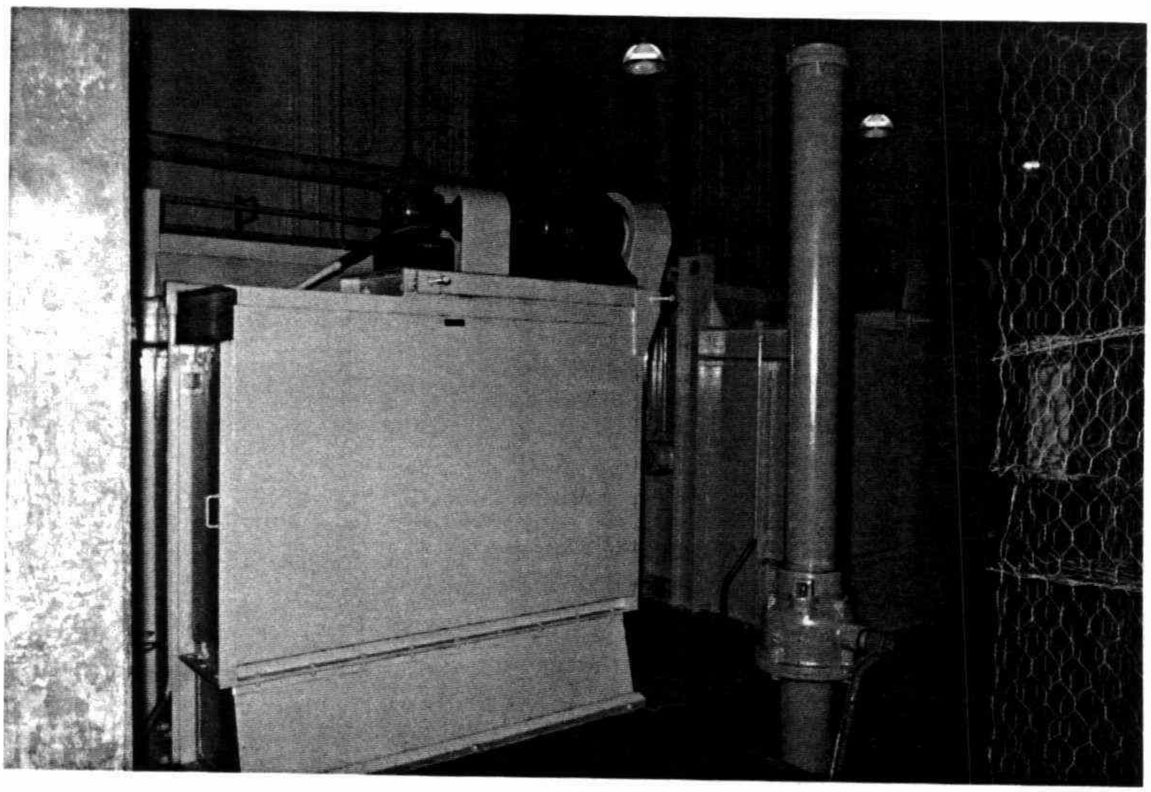
Photograph	Subject
25	Sodium Silicofluoride Feeder
26	Instrument Air Compressors
27	Boilers - Hot Water Heating System
28	Laboratory - Counter with Sample Sink
29	Laboratory - Island Assembly Cabinets
30	Main Control Panel - Distribution System
31	Main Control Panel High Lift Pumps, Filter Plant, Low Lift Pumps
32	Main Control Panel - Booster Pumping Station
33	Main Control Panel - Terminal Reservoir, Port Burwell
34	Main Control Panel - High Lift, Filter Plant
35	Main Control Panel - Low Lift

1. Water Treatment Plant - Front Elevation

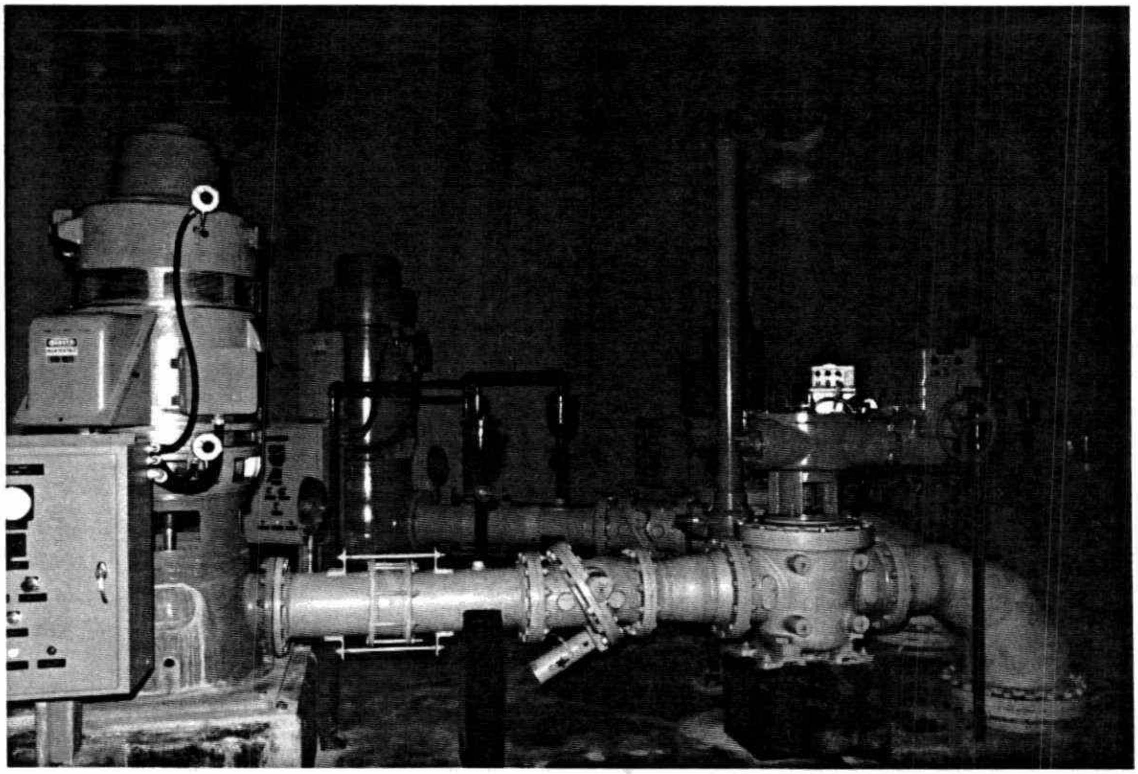
2. Chlorination Building - Front Elevation



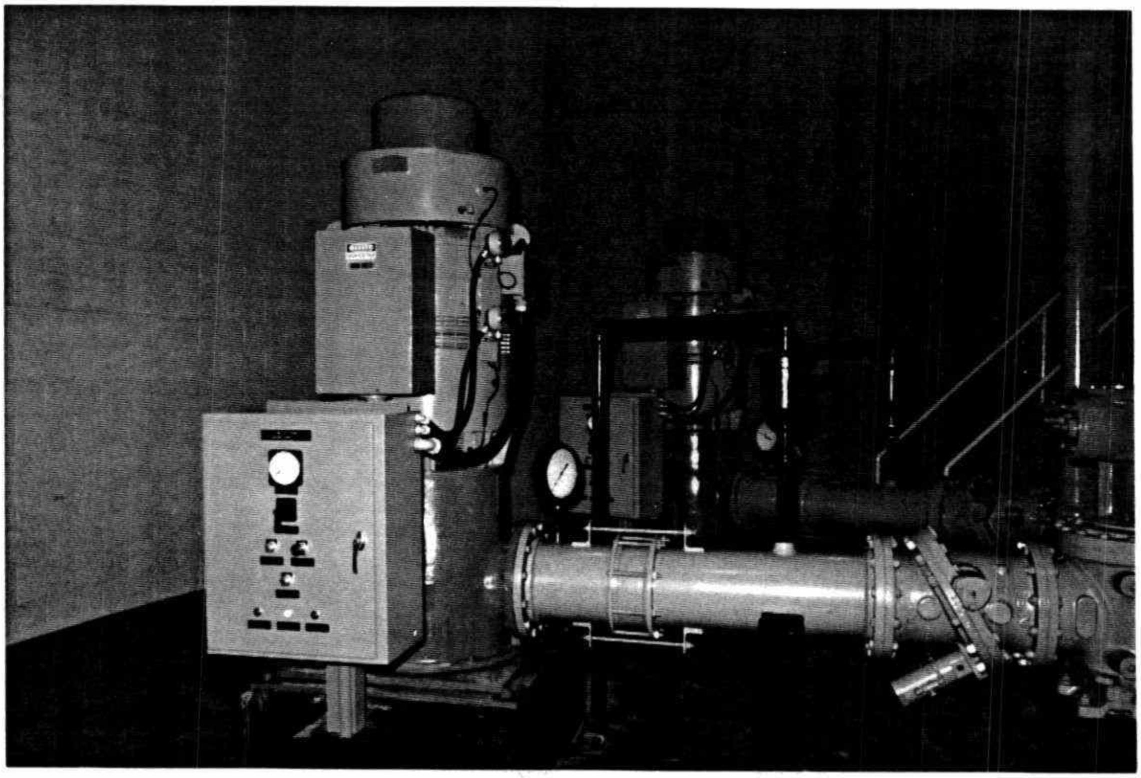
3. Low Lift Pumping Station



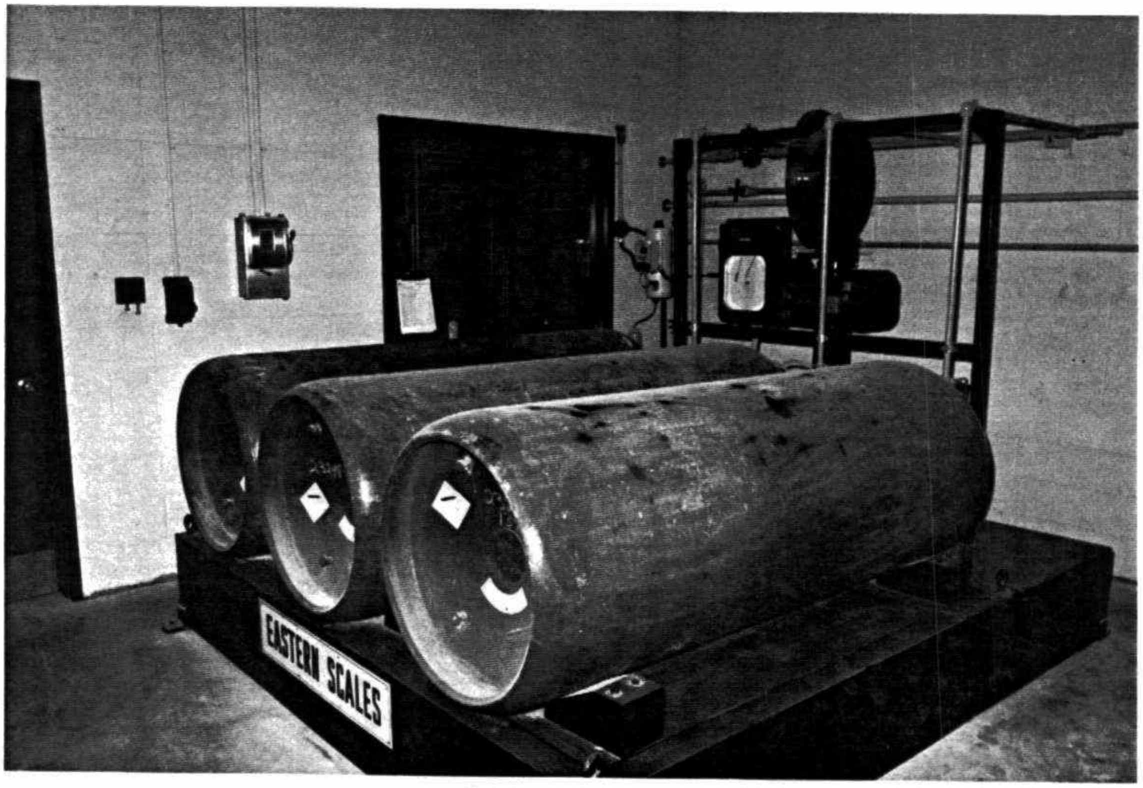
4. Travelling Water Screens



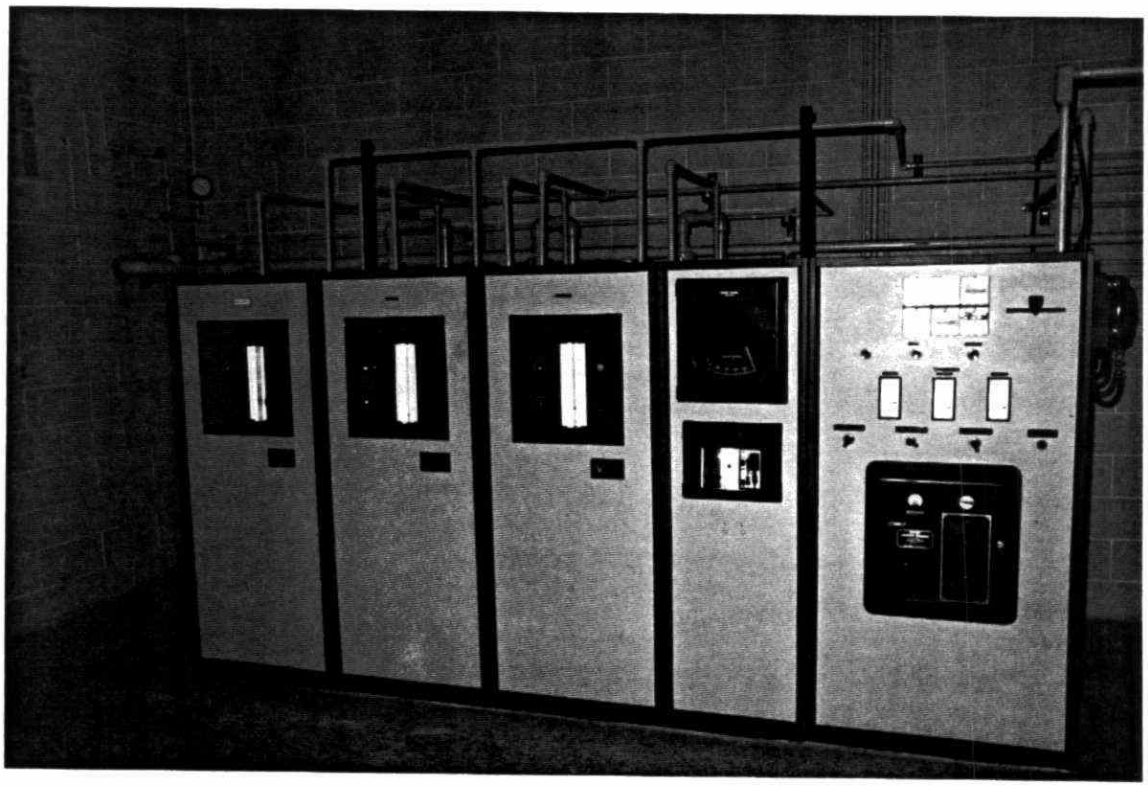
5. Low Lift Pumps and Discharge Piping



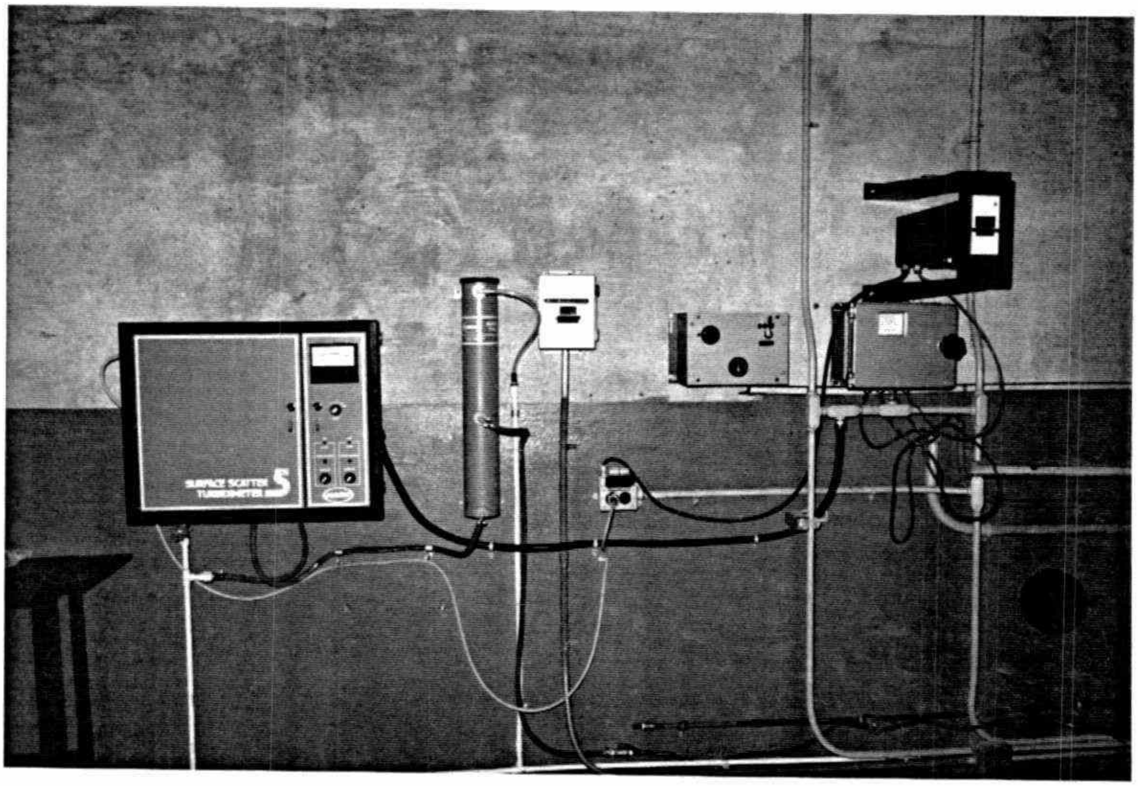
6. Low Lift Pump



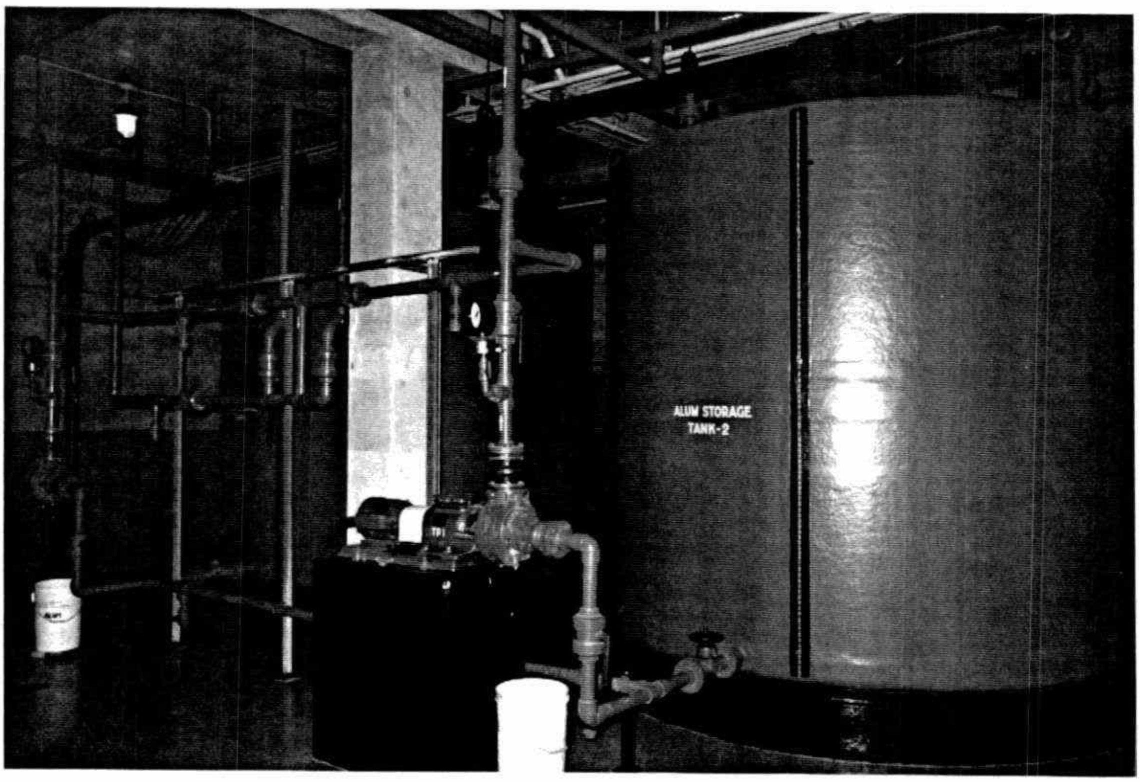
7. Chlorine Weigh Scale



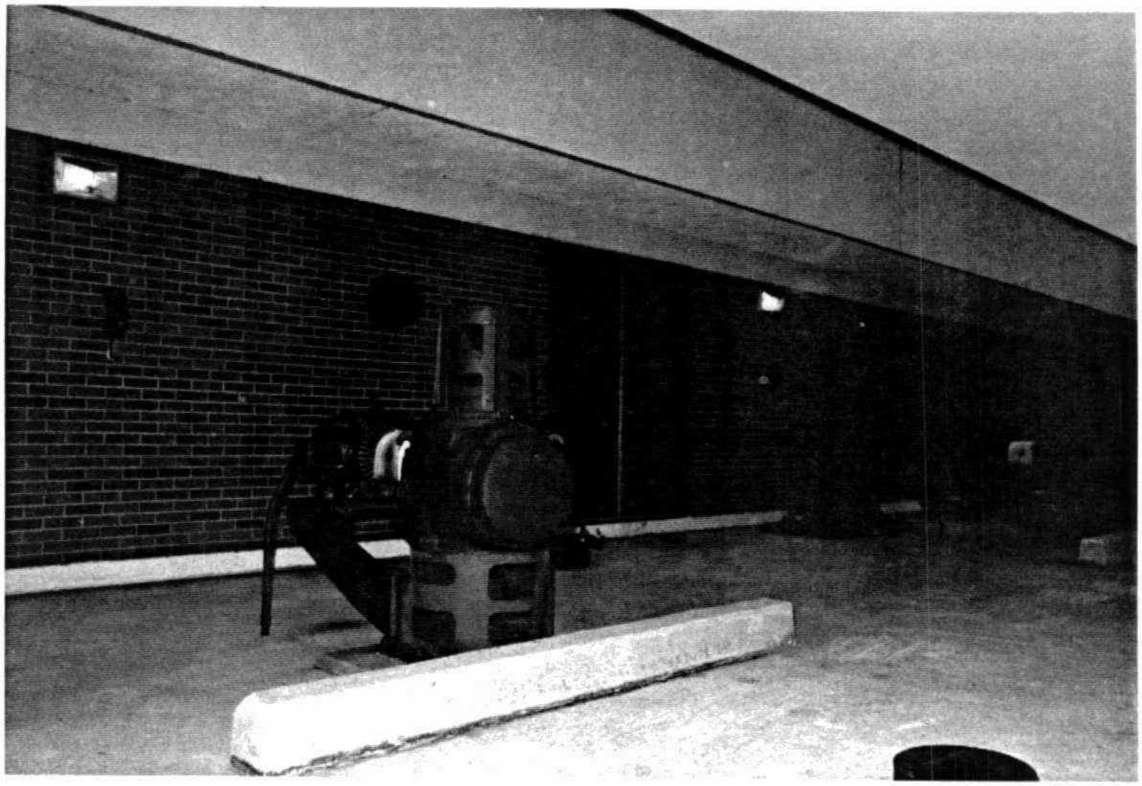
8. Chlorinators, Chlorine Analyzer, and Chlorine Control Panel



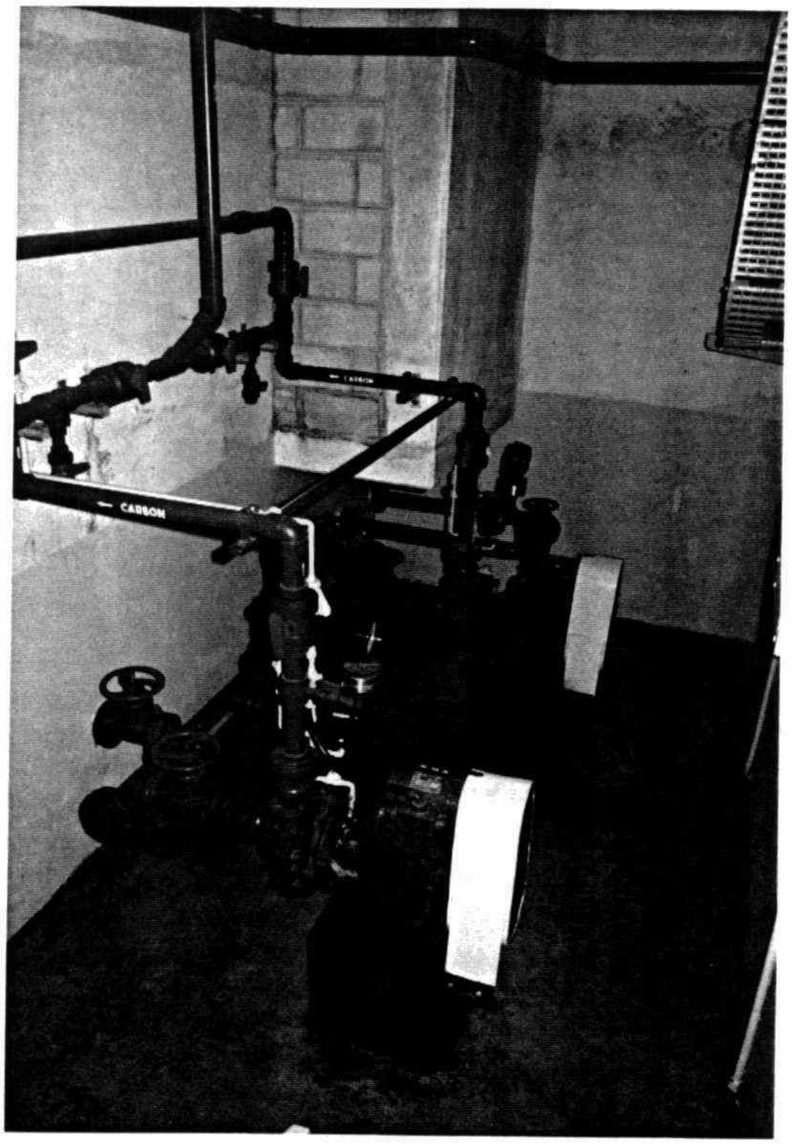
9. Raw Water Pipe Gallery - Flow and Turbidity Metering Instrumentation



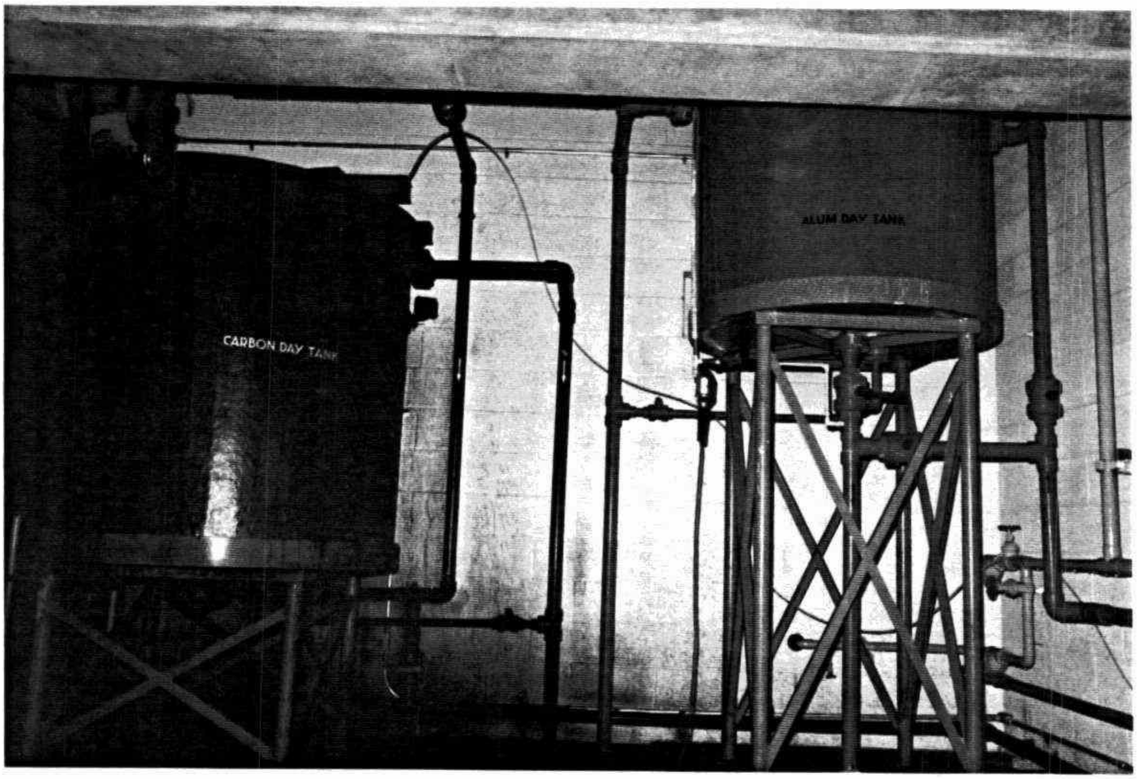
10. Alum Storage Tanks and Transfer Pumps



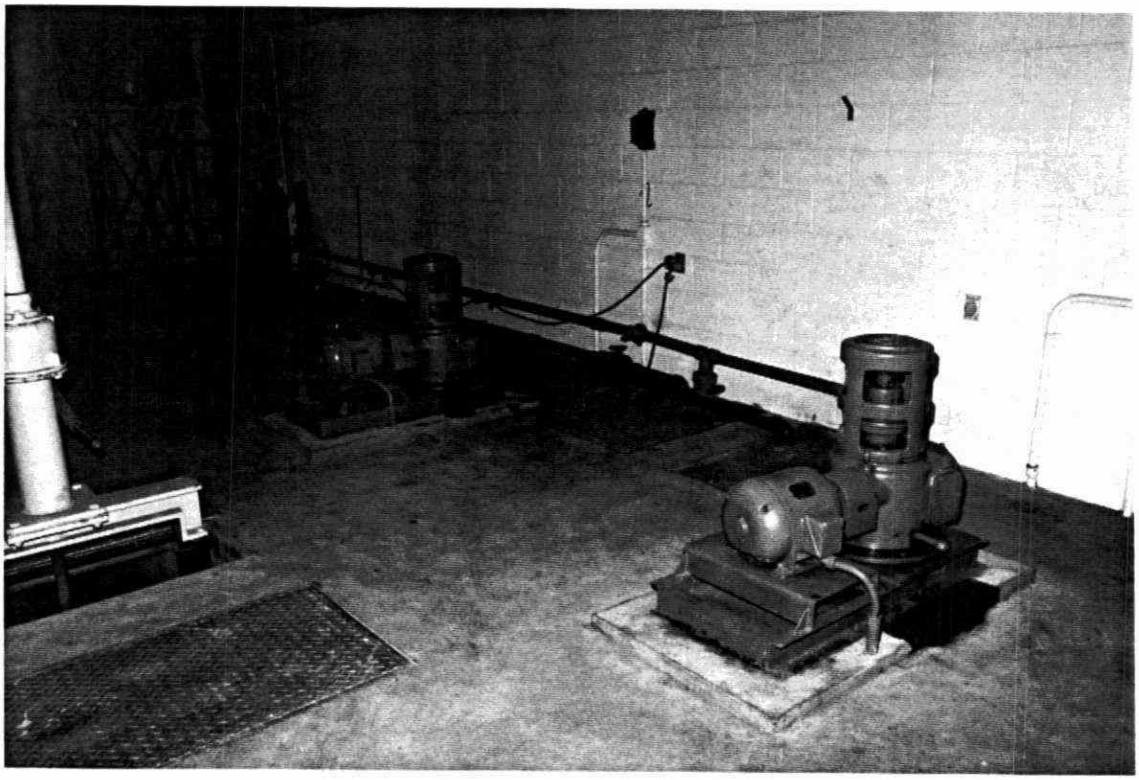
11. Carbon Slurry Mixer



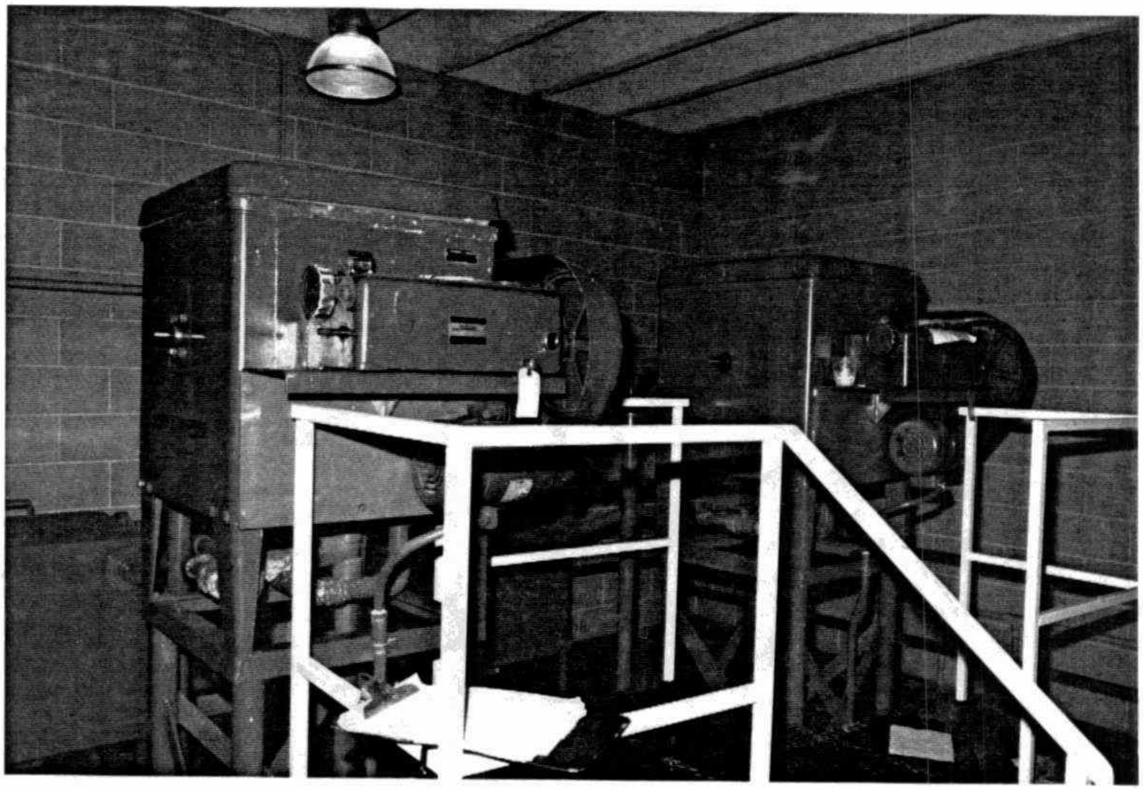
12. Carbon Slurry Transfer Pumps



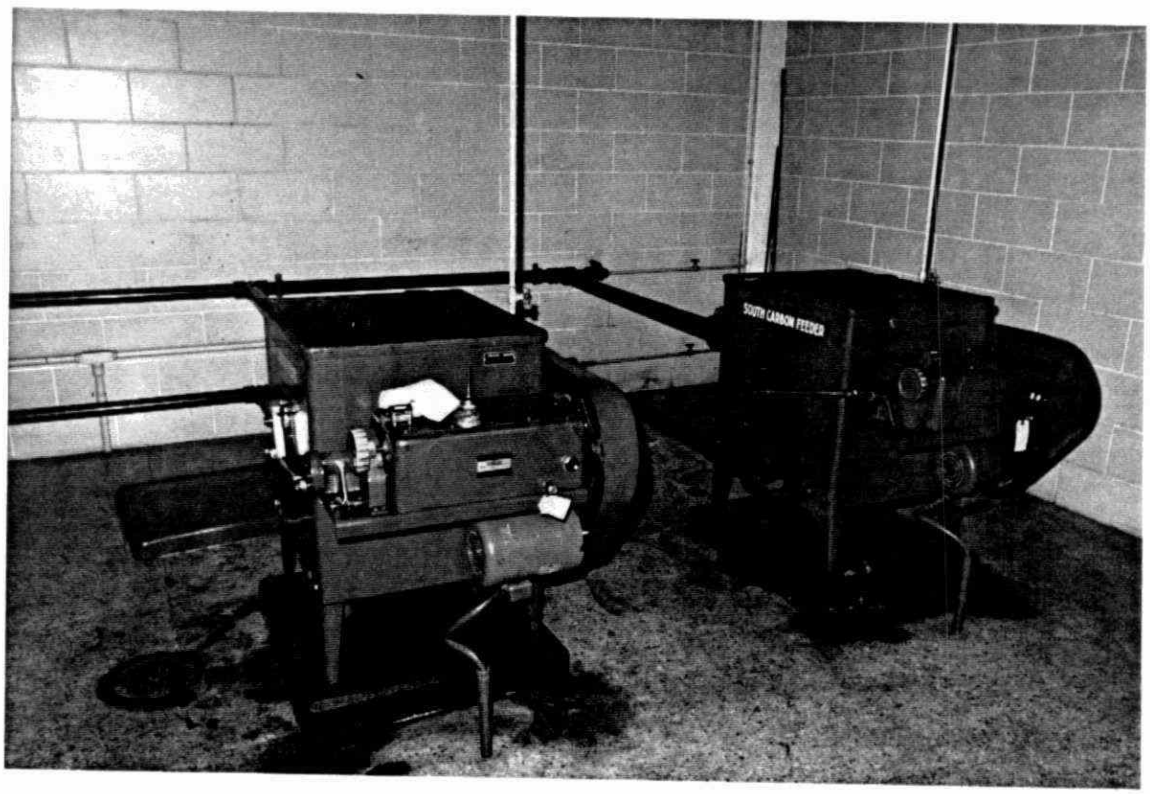
13. Carbon Slurry and Alum Day Tanks



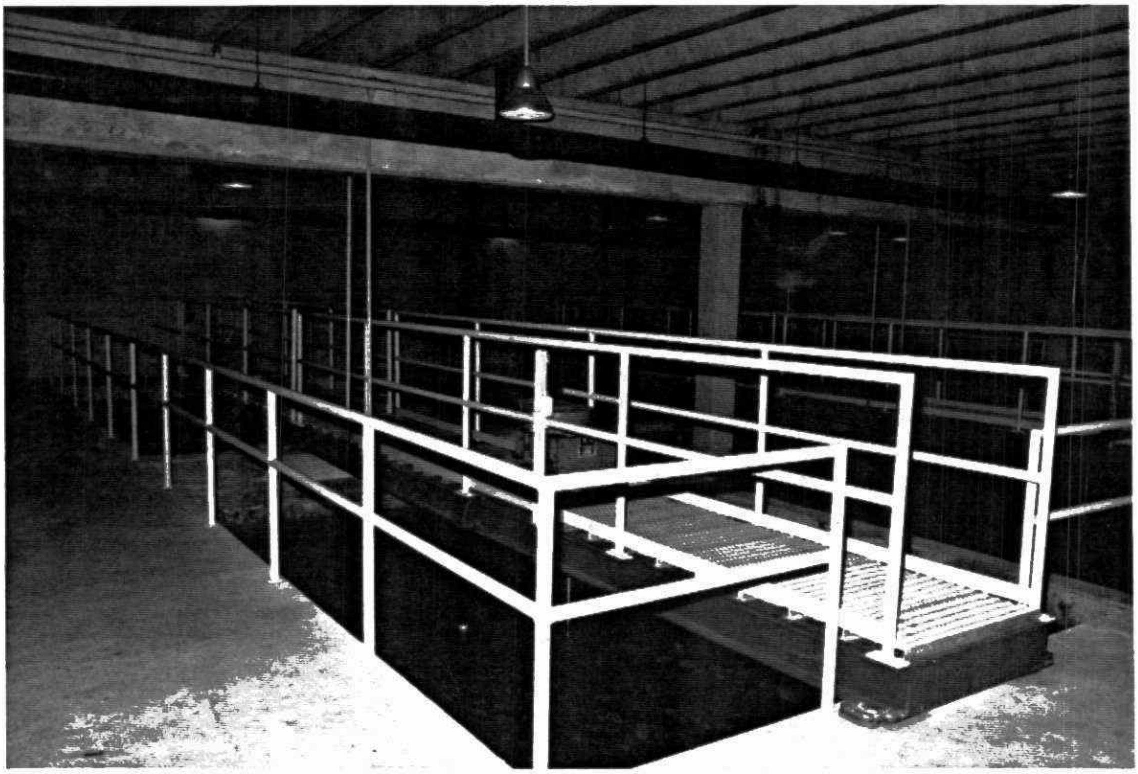
14. Vertical Turbine Rapid Mixers



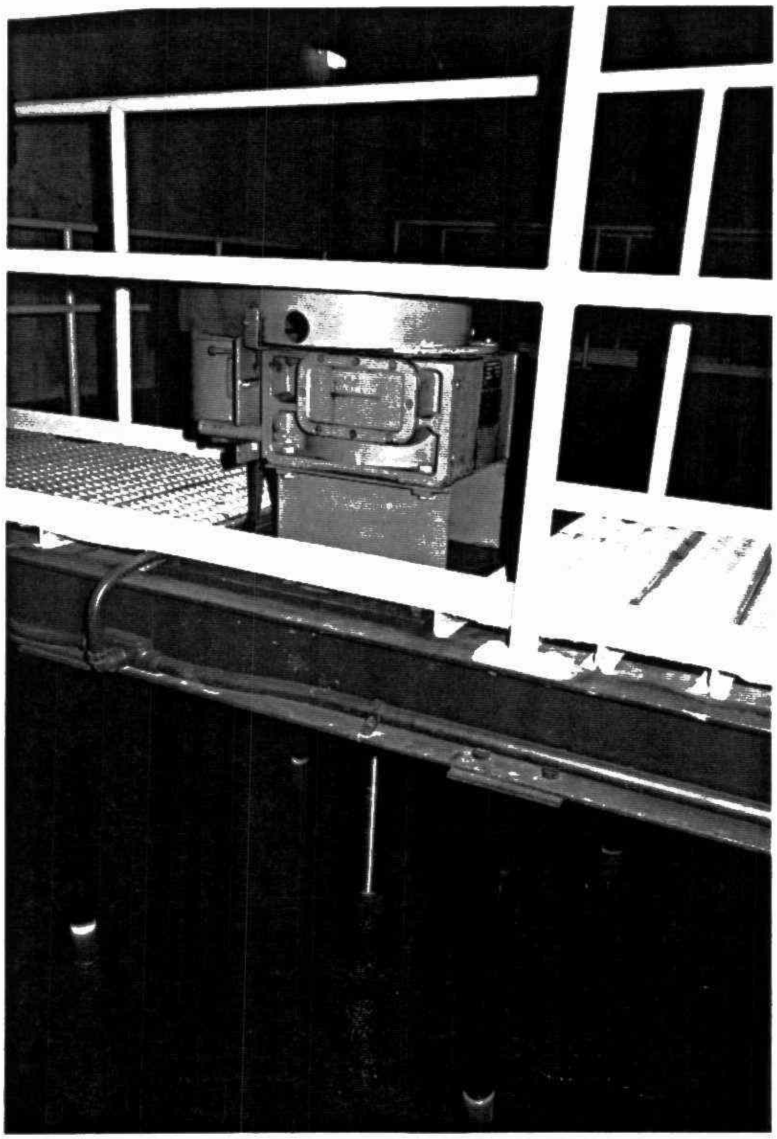
15. Rotodip Alum Feeders



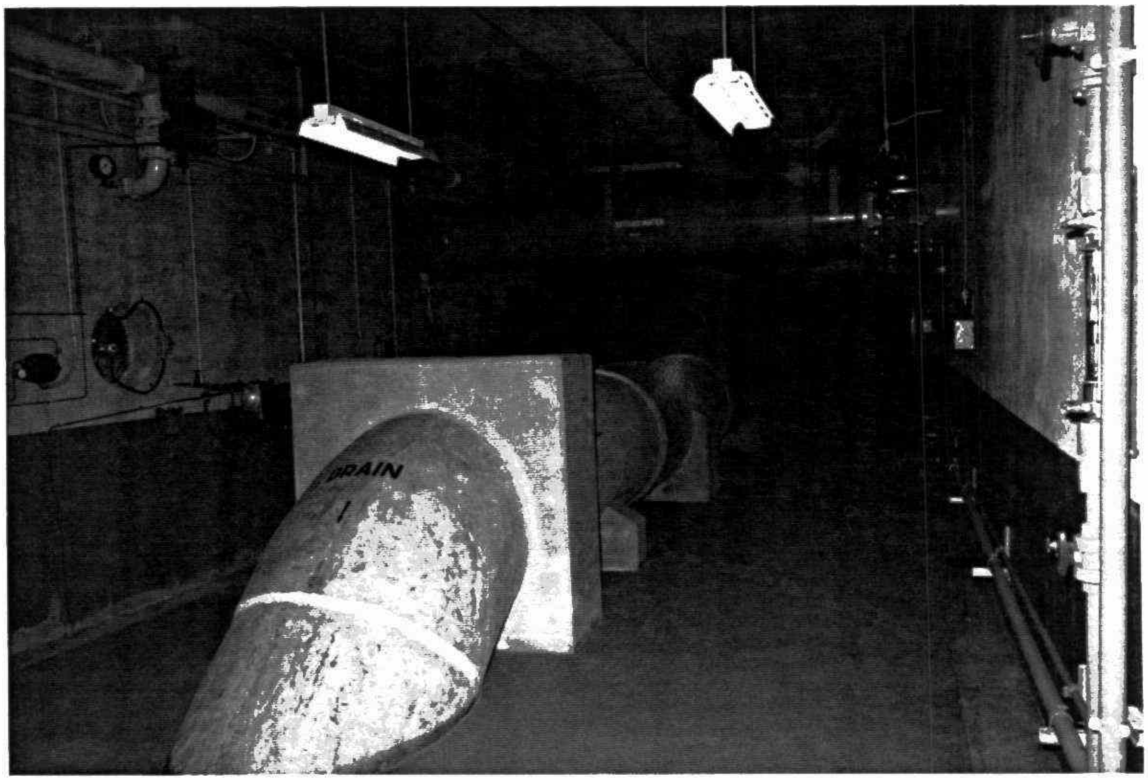
16. Rotodip Carbon Slurry Feeders



17. Flocculation Tank



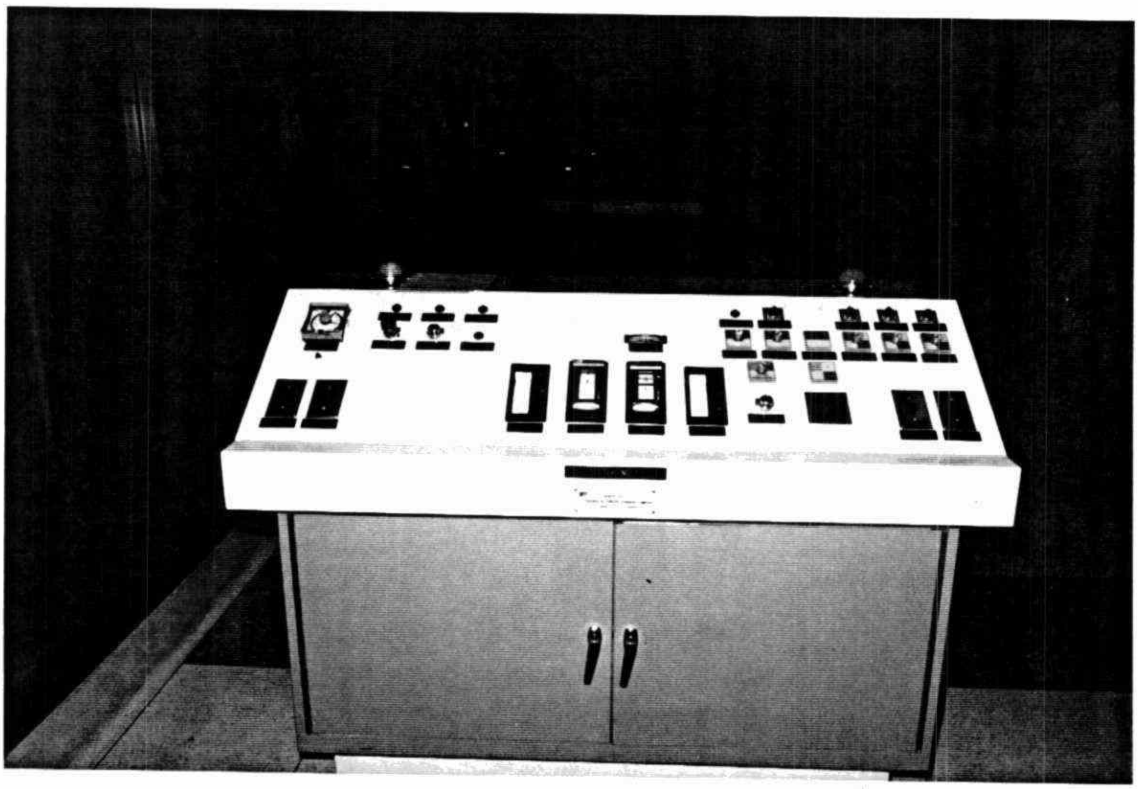
18. Vertical Turbine Flocculator



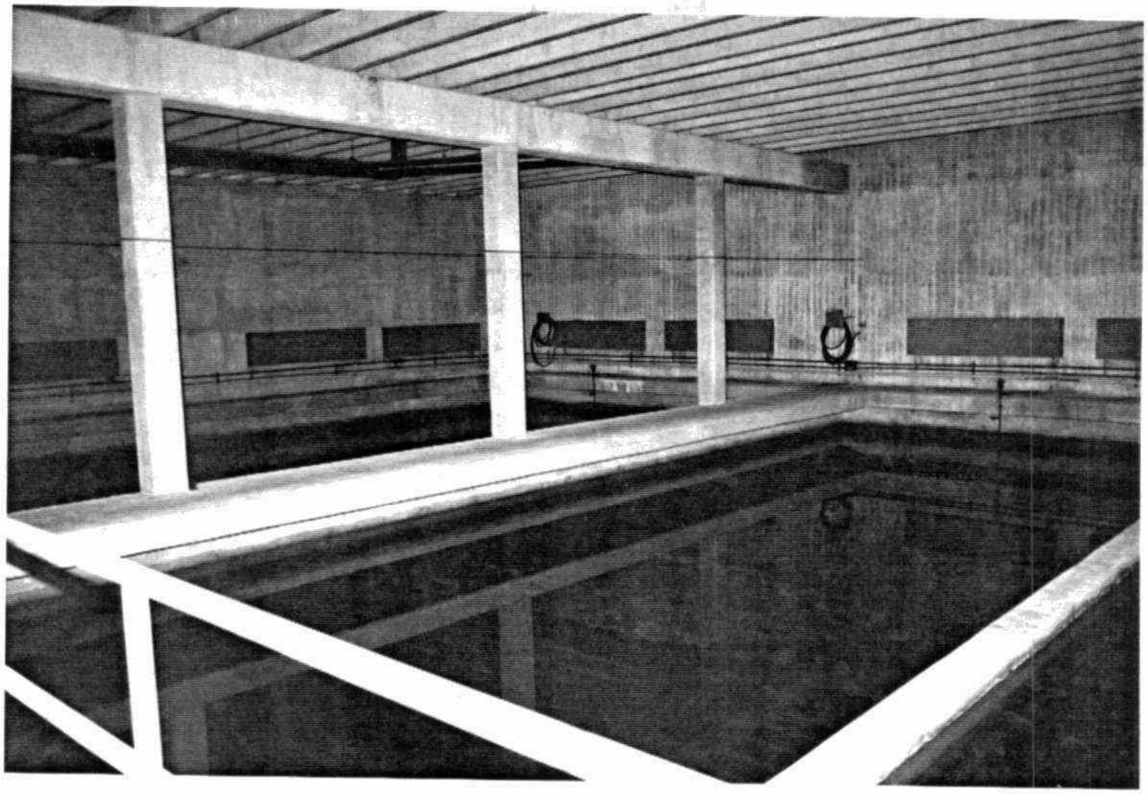
19. Upper Filter Pipe Gallery - Filter Inlet and Washwater Drain Piping

20. Lower Filter Pipe Gallery - Filter Effluent and Washwater Piping

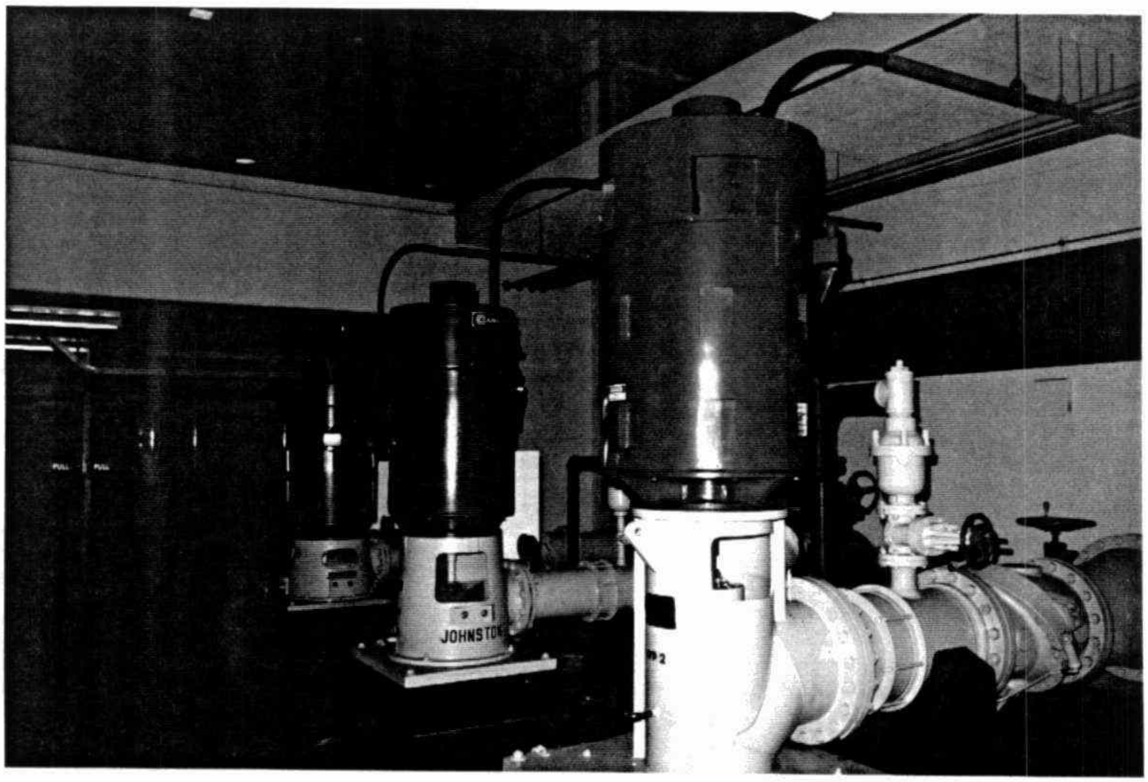
21. Filter Control Gallery



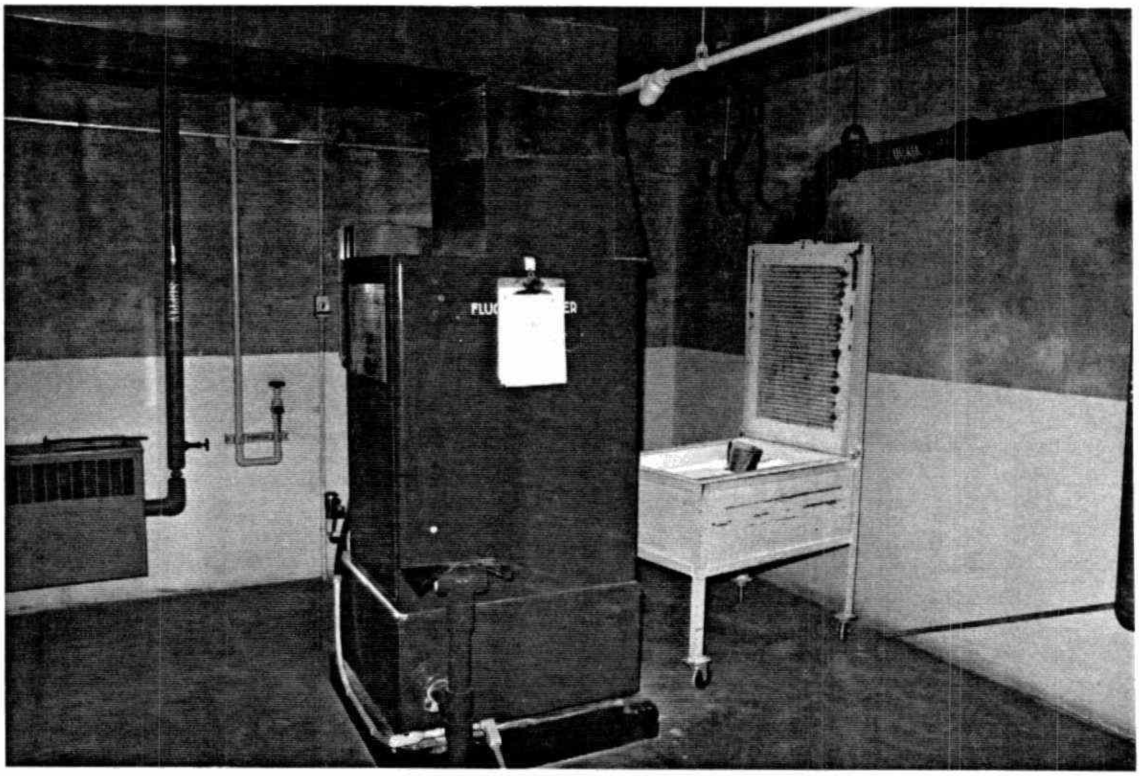
22. Filter Control Console



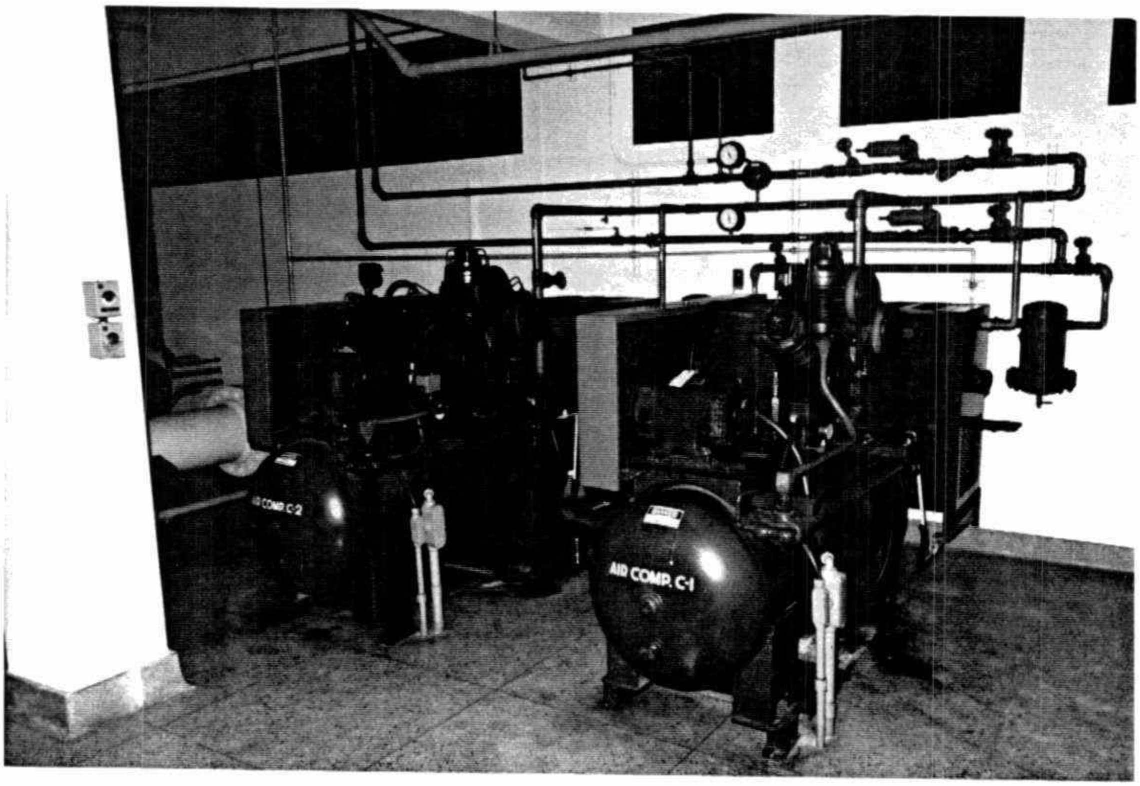
23. Gravity Filters



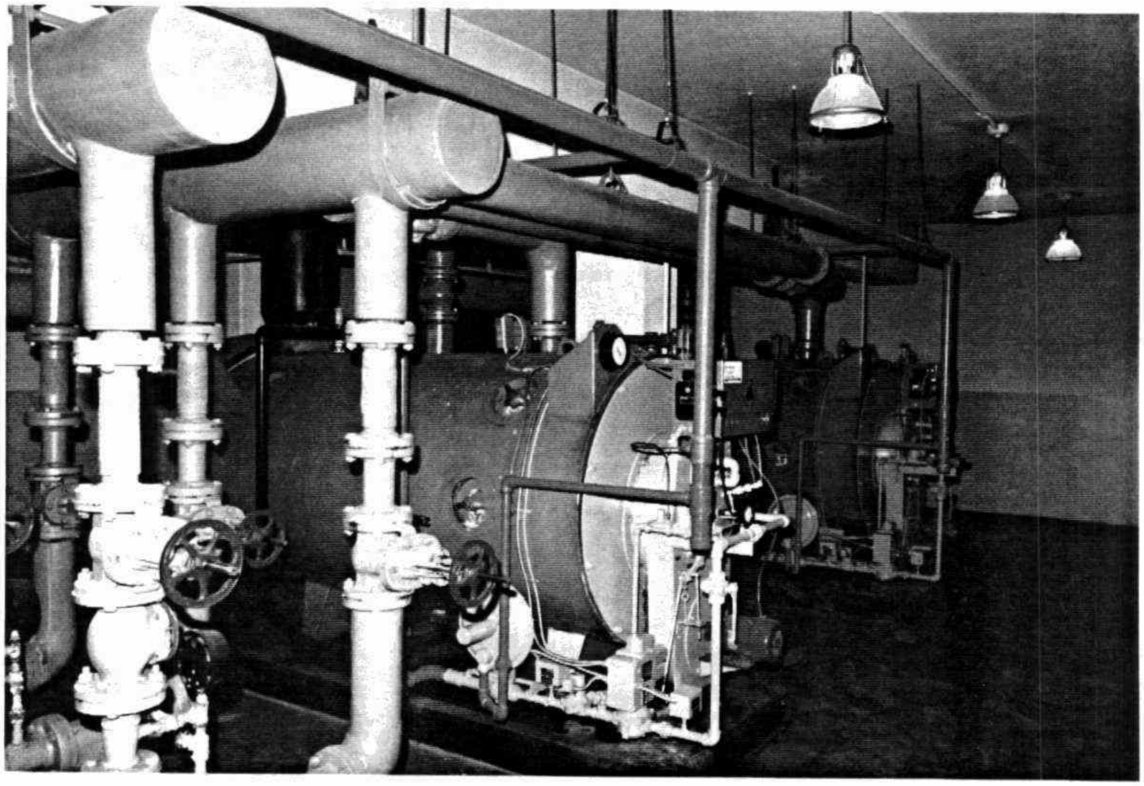
24. High Lift Pumping Station - Two High Lift and One Filter Backwash Pump



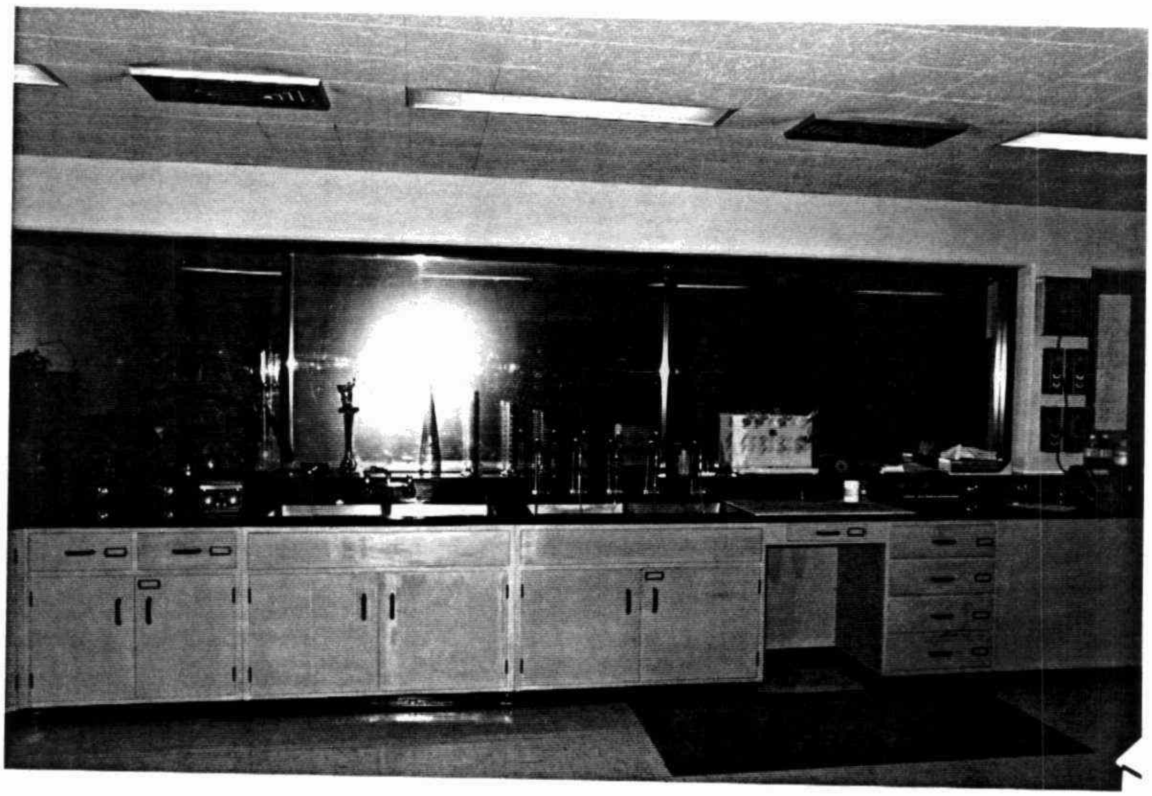
25. Sodium Silicofluoride Feeder



26. Instrument Air Compressors

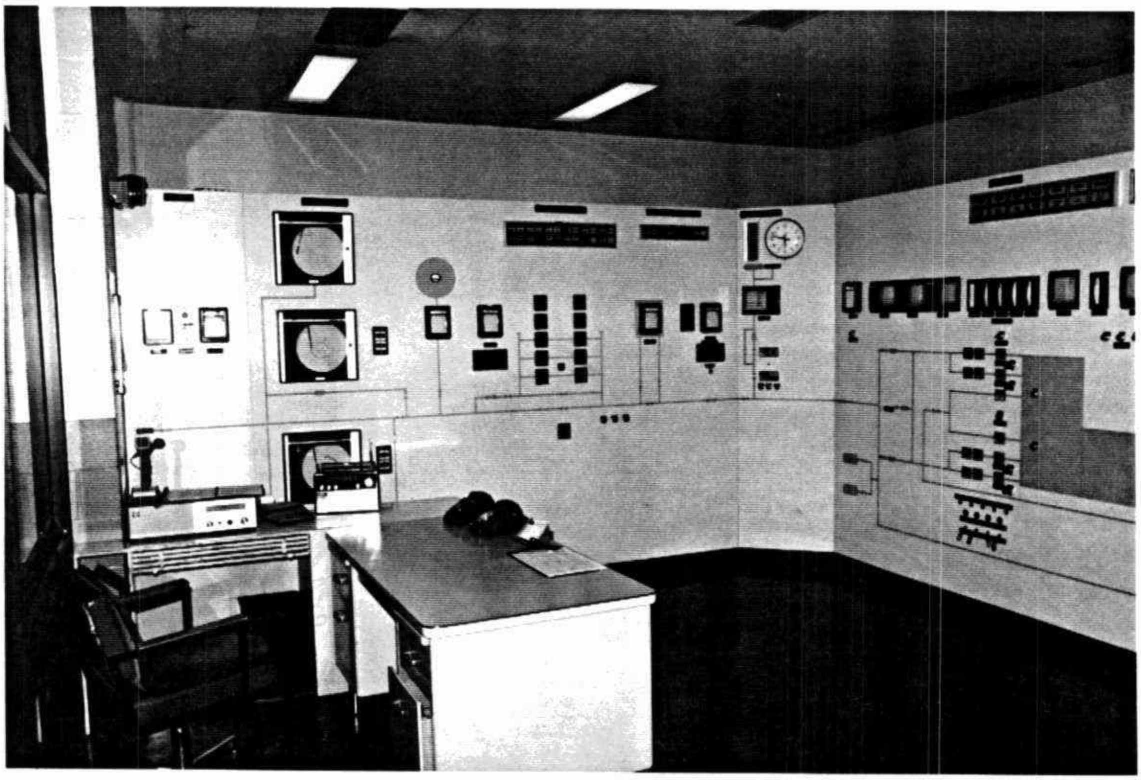


27. Boilers - Hot Water Heating System

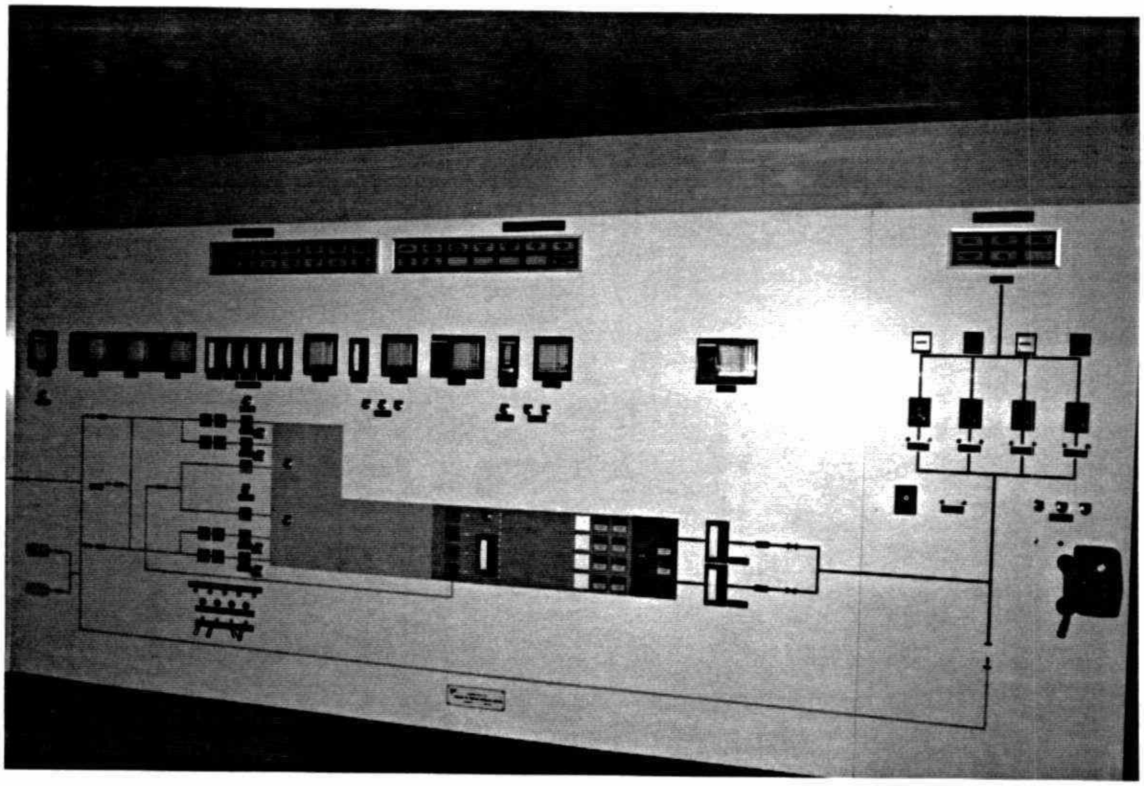


28. Laboratory - Counter with Sample Sink

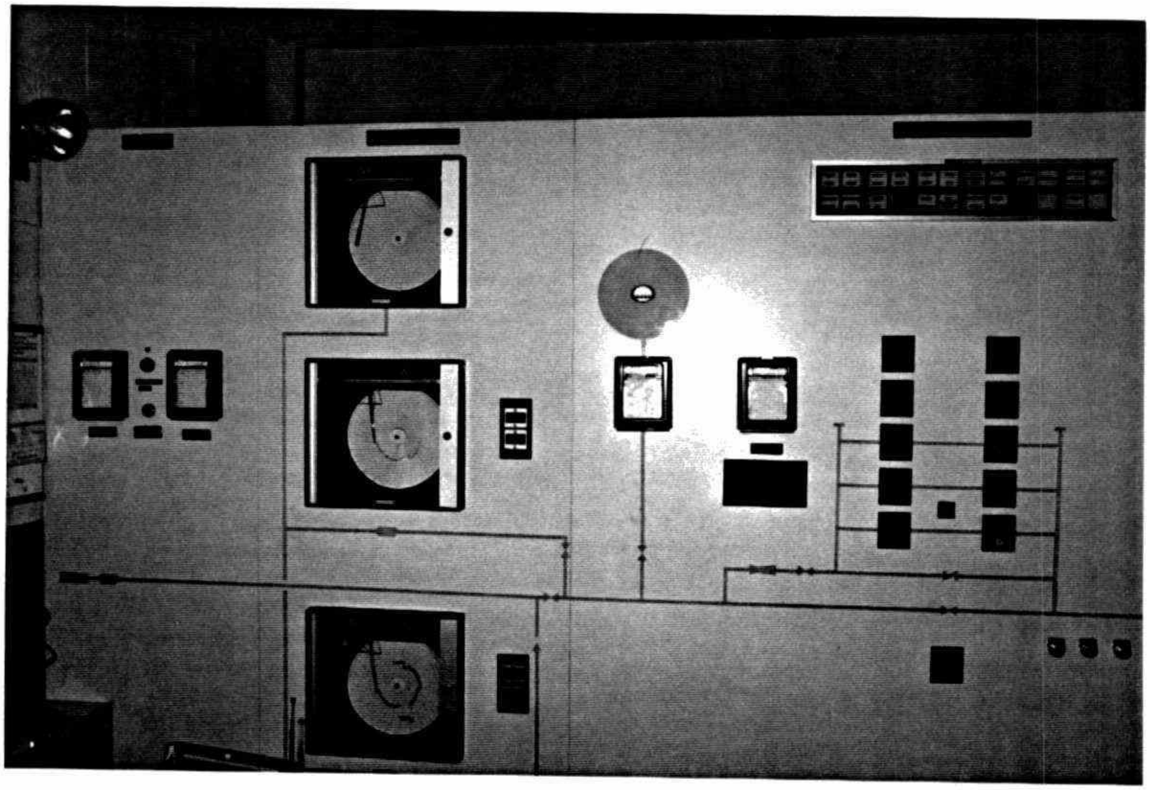
29. Laboratory - Island Assembly Cabinets



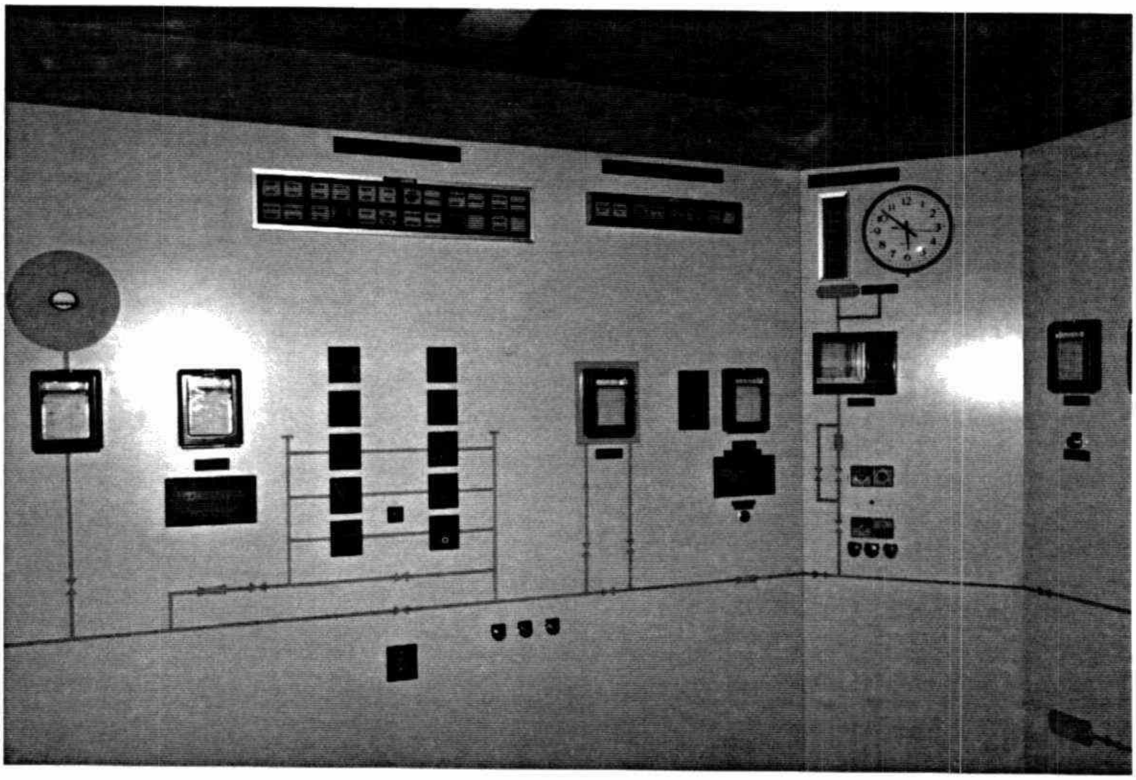
30. Main Control Panel - Distribution System



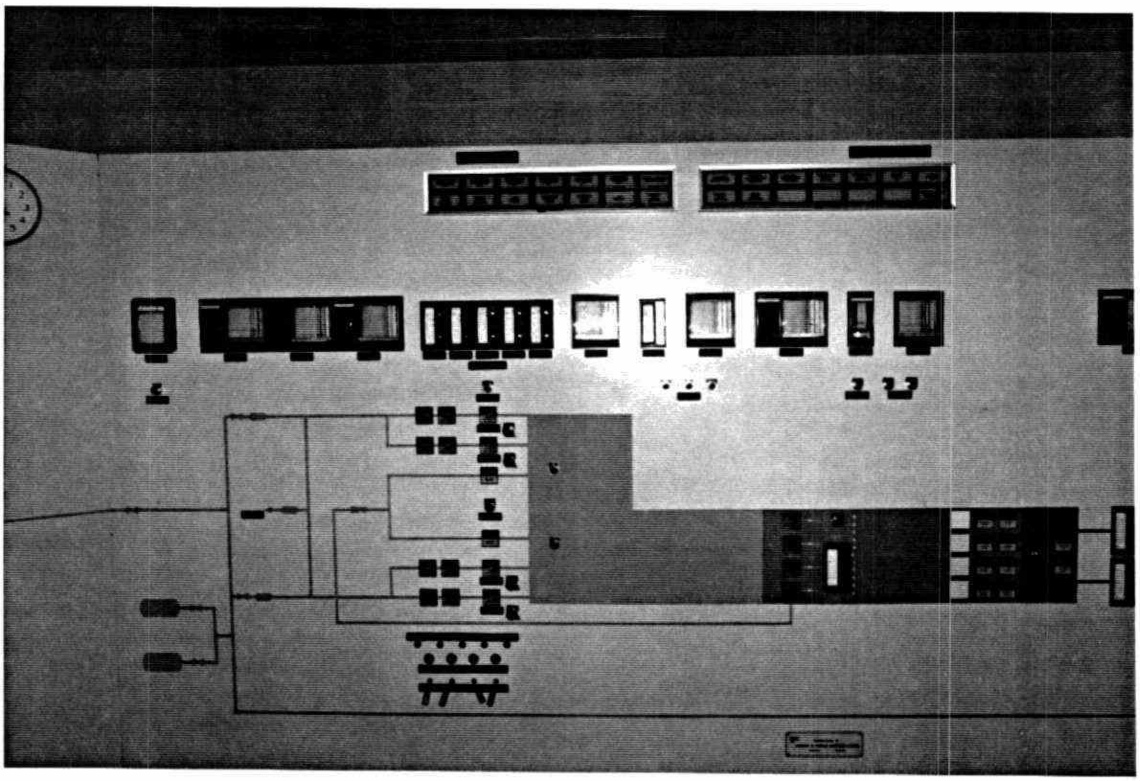
31. Main Control Panel - High Lift Pumps
Filter Plant, Low Lift Pumps



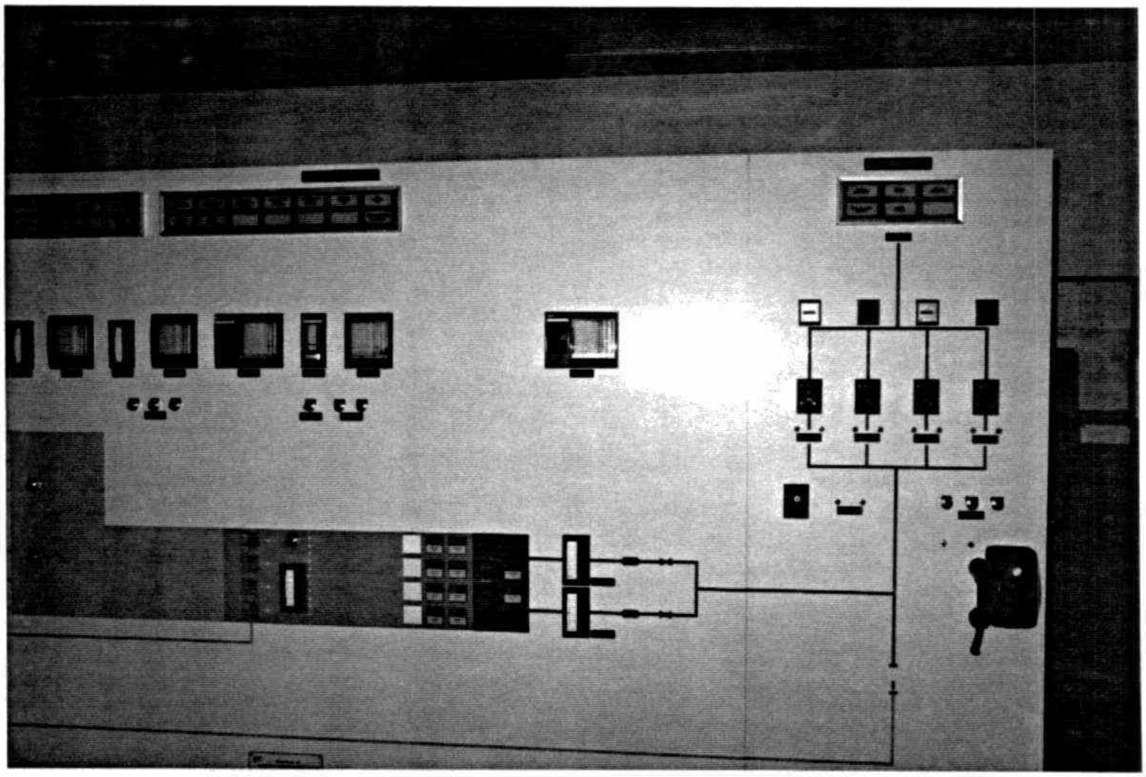
32. Main Control Panel - Booster Pumping Station



33. Main Control Panel - Terminal Reservoir
Port Burwell



34. Main Control Panel - High Lift, Filter Plant



35. Main Control Panel - Low Lift

SECTION D

PLANT OPERATION

D. PLANT OPERATION

D.1 GENERAL DESCRIPTION

a) General

The St. Thomas (Elgin Area) Water Treatment Plant is operated on a continuous basis by the Ontario Ministry of the Environment to supply drinking water to the City of St. Thomas, the Ford of Canada Car Assembly Plant at Talbotville, the Villages of Port Burwell and Vienna and the Townships of Malahide, Yarmouth, Southwold and Bayham. The total population of the service area is about 32,000.

The plant design is based on the conventional treatment process for particulate removal comprising flash mixing, flocculation, sedimentation and gravity filtration. Chemical treatment processes consist of coagulation, disinfection, control of taste and odour, and fluoridation.

b) Operation

The plant is operated on the basis of remote manual and local manual control. An analogue supervisory control system is available whereby the plant can be operated automatically with the exception of chemical feed systems which must be initiated on a manual basis.

Operating staff consists of the following:

- Plant Superintendent
- 1 Assistant Superintendent
- Senior Operator
- 4 Operators
- 3 Mechanical Maintenance Technicians
- Electrician
- Instrument Technician
- Janitor

Water quality control analyses, described later in Section D.6, and jar tests are performed by the operators in the Plant Laboratory.

The plant operates on the basis of 2-12 hour shifts per day, 7 days per week. Two operators are on duty during the day shift and one operator mans the night shift. During the day shift the team is supported by the Superintendent and Assistant Superintendent.

One operator staffs the control room while the second operator on the day shift monitors plant operations, carries out water quality tests, sets chemical feed rates, confirms the accuracy of on-line monitors, is in charge of receiving chemical deliveries, and backwashes filters.

Record keeping consists of maintaining the Daily Log Sheet and the Daily Lab Report. These two reports are combined monthly into the Operating Report. In addition, plant staff prepare an additional monthly Utility Monitoring System Report and a yearly Plant Operation Summary.

D.2 FLOW CONTROL

a) Low Lift Pumps

Control of the low lift pumps is remote manual from the main control panel based on level in the settled water conduit - obtained from the level indicator. Shut-down is also manual following a high level alarm; but pumps will shut-off automatically if there is no operator response.

The control of the motorized pump discharge valve is interlocked with its related low lift pump control circuit, so that the valve functions as a combined stop-check-throttle service. This function eliminates hydraulic shocks associated with starting and stopping of pumps. The motorized valves will also permit pumps to be trim-throttled.

b) Filters

Filters are operated on the principle of constant rate filtration. Flow through the plant is divided equally by all on-line filters.

Filter rate control can be either automatic or manual. In the manual mode filters run at constant rate controlled by a filter rate controller. The filter rate is set manually on the rate controller. A Venturi tube flow meter in the discharge pipe provides the flow rate for comparison to the set point. Deviations in flow rate are adjusted automatically from the rate controller by opening or closing of the rate control valve.

In the automatic mode filters operate at variable rate, controlled on filtered-water reservoir level. The filter rate set point is selected and adjusted automatically based on design flow capacity of the filters and the position of the level in the reservoir. The entire depth in the reservoir is used for variable rate control. The remote filter flow rate setting signal, Q_F, is equal to the proportional level band, L (full reservoir depth minus actual depth), divided by the rate conversion coefficient, K_2. On high water level the filters shut-down.

Filters are operated to a total head loss of about 1.8 m at which point an alarm will sound alerting the operator to initiate the backwash cycle. Once initiated, filter backwashing is done automatically and controlled by an analogue filter backwash controller. At the end of the backwash cycle the filter is automatically returned to service by slowly opening the filter rate control valve which is equipped with a powered valve positioner. A stepping drive relay in the filter rate controller will limit the rate of flow acceleration while the filter is being started up.

c) <u>High Lift Pumps</u>

Control of the treated water pumps and their discharge valves is Remote Manual from the plant main control panel based on water level in the Centennial Avenue Reservoir. On high level pumps are shut-down manually by the operator.

Emergency Stop push-buttons and pump lock-outs are available on local pump control panels.

Telemetering of information between the distribution system and control room at the treatment plant is available by telephone circuits. Water level circuits for the elevated tank and distribution system reservoir at one time were used to automatically control the high lift pumps at the treatment plant.

Pumps at the Booster Pumping Station are started and stopped automatically based on level in the St. Thomas elevated tank.

The Booster Pumping Station has three horizontal, centrifugal pumps rated 263 L/s at 41 m total head. An electric diesel generator serves to provide standby power for one pump.

The St. Thomas elevated tank has a capacity of 799 m^3 at top water level of 289.56 m.

D.3 DISINFECTION PRACTICES

Pre- and postchlorination for disinfection is practiced at the plant. The prechlorine dosage is applied after sedimentation rather than before rapid mixing in order to avoid chlorine consumption by powdered activated carbon. It was found that carbon increased the chlorine demand by about 18 to 20 percent.

The prechlorinator dosage is set manually and paced on summated filtered water flow. Dosage is selected in order to maintain a free chlorine residual of about 0.75 mg/L after the filters. No chlorine demand test results were available at the plant.

The postchlorinator is operated similarly to the prechlorinator except that the machine is paced to maintain constant dosage on summated treated water flow. The chlorine diffuser in use is located in the high lift suction conduit. An alternate application point in the filtered water conduit, which conveys water to the clear well and reservoir, is not currently used for postchlorination. Dosage is set to maintain a total chlorine residual of 0.9 to 1.0 mg/L in the treated water pumped to the distribution system. An auto-chlorine analyser continuously monitors the chlorine residual of the final effluent.

D.4 OPERATION OF SPECIFIC COMPONENTS

D.4.1 INTAKE

No special operating procedures apply to the intake. No problems have been encountered - either with the accumulation of sediments or frazil ice during the winter. Shut-off gates are available to isolate the intake from the Low Lift Pumping Station.

Facilities for backflushing of the intake are available but have never been used.

D.4.2 SCREENING

Screens are in good condition. They are self-cleaning when in operation. Wastes are discharged to the drain sump and back to the lake via the 900 mm dia. plant drain.

D.4.3 LOW LIFT PUMPS

Pumps have performed well. No problems are being experienced. Pumps are selected to match treated water flow. Hydraulic surges as a result of starting and stopping pumps are minimized due to slowly opening and closing motorized pump discharge valves.

D.4.4 RAPID MIXING AND FLOCCULATION

Only one pretreatment module is used at any one time because water production requirements so far have been low. Tanks in service are alternated relative to the timing for manual clean-out of the sedimentation basins.

Rapid mixers and flocculators are manually controlled from local start/stop push-button loading stations.

D.4.5 SEDIMENTATION

Sedimentation basins follow rapid mixing and flocculation tanks and are operated alternately in unison with the coagulation and flocculation tanks in service.

Sludge removal is manual and is carried out routinely on a three months schedule. Settled sludge is discharged to the plant drain.

D.4.6 FILTERS

Filters are operated on the basis of constant rate. Control is automatic by individual rate controllers which compare actual flow with a set point manually set by the operator and adjust the rate control valve to maintain constant flow. Two, three or four filters are operated simultaneously depending upon the level of plant flow.

Filters are monitored for flow, head loss and effluent turbidity. Filters are backwashed manually on the basis of high head loss (2.4 m max.) or the length of filter run (varying from 72 to 84 hours). A head loss of about 1.8 m will sound an alarm alerting the operator to initiate the backwash. Once initiated, filter backwashing will proceed automatically in accordance with the program of the analogue controller. Backwashing is done first at low rate, then at high rate by controlling the operation of the two backwash pumps. Surface agitors come on-line at the beginning of the wash cycle and run for about 3 minutes. Agitators are controlled automatically by opening/closing of a motorized inlet valve. The duration of a filter wash is about 15 minutes. At the end of the wash cycle, the filter is automatically returned to service. Filter start-up is gradual by opening the rate control valve at a controlled ramped rate. This minimizes hydraulic surges in the filter thus minimizing the potential for turbidity breakthrough to occur.

Filters can be backwashed manually from the control console.

D.4.7 CLEAR WELL

The Clear Well is equipped with one inlet gate (normally open) and one outlet gate (normally closed). The water level is controlled by the weir elevation of the effluent discharge troughs. A chlorine diffuser is located in the filtered water conduit ahead of the inlet gate of the clear well.

D.4.8 RESERVOIR

The Reservoir provides variable storage capacity for balancing low lift and high lift pumping. Flow is conveyed from the Reservoir via the high lift suction conduit to the treated water pump wells. Isolation gates are provided at the reservoir outlet and the individual pump wells.

Chlorine and fluoride diffusers are located in the high lift suction conduit downstream of the reservoir outlet gate.

D.4.9 HIGH LIFT PUMPS

The plant includes two separate high lift pump wells each containing two treated water pumps and one backwash water pump. Pump wells can be isolated from the suction conduit by closing the inlet gates.

The treated water pumps are operated manually from the control room and are selected on the basis of the water level in the distribution system reservoir.

D.5 CHEMICALS

D.5.1 CONTROL OF CHEMICAL DOSAGES

a) Alum

Liquid alum is the primary coagulant used at the plant. The alum dosage is set manually by selecting the proper Rotodip feeder transmission speed. Constant dosage is maintained by a flow-proportional

controller based on raw water flow. Dilution water is added to the metered flow downstream of the feeder.

The applied alum dosage is selected on the basis of the quality of the raw and filtered water. A dosage versus turbidity selection guide assists the operator in selecting the operating dosage based on raw water turbidity. The dosage guide shown in Table D.1, has been developed in the laboratory from jar tests on the raw water with various turbidity levels. Jar tests are based on the standard jar test procedure and establish optimum alum dosage on the basis of visual observations of floc size and settling characteristics.

Alum dosage is calculated by plant staff using daily consumption based on Rotodip revolution counter and total daily raw water flow as follows:

- revolutions x 0.00343 = m^3 of alum solution
- m^3 x 649 = kg of alum
- $\frac{\text{kg alum}}{10^3\ m^3\ \text{(raw water)}}$ = mg/L alum dosage

where:	revolutions	= from Rotodip transmission totalizer
	0.00343	= 24-hour volume conversion
	649	= kg of dry alum per m^3 of solution

The volume to weight conversion factor of 649 was found to be incorrect for commercial strength liquid alum measuring 48.2 percent alum by weight. The correct factor is 640.8 kg dry alum per m^3 of liquid alum solution.

The calculated dosage is checked on a regular basis by comparing calculated consumption with the loss of volume in the day tank.

b) Powdered Activated Carbon

Powdered activated carbon (Hydrodarco B) of 400 mesh size is used all-year-round to control taste and odours. Qualitative tests for odour are

TABLE D.1

ALUM DOSAGE SELECTION GUIDE

Raw Water Turbidity (Ftu)	Alum Dosage (mg/L)
0 - 1	5.5
1 - 2	6.0
2 - 3	6.5
3 - 4	7.0
4 - 5	7.5
5 - 6	8.0
6 - 7	8.5
7 - 8	9.0
8 - 9	9.5
9 - 15	10.0
15 - 25	12.5
25 - 35	15.0
35 - 50	17.5
50 - 65	20.0
65 - 80	22.5
80 - 100	25.0
100 - 120	27.5
120 - 140	30.0
140 - 165	32.5
165 - 190	35.0
190 - 215(1)	37.5

(1) For higher raw water turbidities, alum dosage is increased by 2.5 mg/L for each successive rise of 25 Ftu in raw water turbidity.

done by the plant operators frequently during the day. No formal threshold odour number has been established, but operators have developed a basic dosage chart guide based on qualitative tests. This chart is used to manually set the dosage on the Rotodip feeders. Dosage is maintained by a flow-proportional controller based on raw water flow. Typical dosages are: winter - 2.0 mg/L, summer - 5.0 mg/L average with maximums of 10.0 mg/L and even as high as 30 mg/L.

Upon delivery, dry powdered activated carbon (PAC) is slurried in the bulk storage tanks in the ratio of 1 lb. PAC to 1 I.gal of water. This slurry concentration is maintained in the day tank and is applied by Rotodip feeder to the rapid mix tank.

Dosage is calculated daily as follows:

- revolutions x 0.00305 = m^3 of PAC slurry
- m^3 x 100 = kg of PAC, or
- revolutions x 0.305 = kg of PAC
- $\dfrac{\text{kg PAC}}{10^3\ m^3\ \text{(raw water)}}$ = mg/L PAC dosage

where: revolutions = from Rotodip transmission totalizer
0.00305 = 24-hour volume conversion
100 = weight of carbon in kg per m^3 of slurry

c) Chlorine

As described previously, chlorine gas is used for disinfection. Basically, the water flowing through the plant is prechlorinated for disinfection and postchlorinated to maintain a chlorine residual in the water distributed for consumption.

The chlorine dosage is calculated using total daily chlorine consumption and daily water treated. For example,

- $\dfrac{\text{kg chlorine}}{10^3\ m^3\ \text{(water treated)}}$ = mg/L Cl_2 dosage

Chlorine weight, in kg, is obtained from the chlorine scale weight indicator reading multiplied by 0.4356. For establishing the pre-chlorine dosage, the total filtered water flow is used in the calculation while for the post-chlorine dosage, the total of treated water, service water and filter backwash water is used. Since scale weight represents the total chlorine used, the respective dosages are calculated as follows:

- post-chlorine = hourly feed rate x high lift pump hours (24 total per day)

- pre-chlorine = total scale weight - post-chlorine consumption.

If the scale is not working, the pre-chlorine consumption is calculated on the same basis as the post-chlorine consumption.

d) Fluoride

Fluoride in the form of dry sodium silicofluoride is added to the treated water via a diffuser located in the high lift pump suction conduit. Fluoride dosage is selected manually to maintain a fluoride concentration of about 1.2 mg/L in the treated water. The feeder is paced on treated water flow. Treated water is analysed daily at the plant to ensure that the effluent concentration objective is achieved.

The fluoride dosage is calculated using daily consumption from the loss of weight recorder as follows:

- recorder x 0.4536 = kg
- $\dfrac{\text{kg } Na_2SiF_6 \times 0.6}{10^3 \times m^3 \text{ (water treated)}}$ = mg/L F dosage

The amount of water treated is obtained by adding totalizer readings for treated water, service water, and filter backwash water.

D.6 SAMPLING AND DATA COLLECTION

D.6.1 PLANT RECORDS

The following records are kept by the operators for monitoring plant operations:

1) Daily Log Sheet
2) Daily Lab Report
3) Monthly Operating Report
4) Monthly Utility Monitoring System Report
5) Yearly Plant Operation Summary.

Examples of the Daily Log Sheet and the Daily Lab Report are included in Appendix A of this report.

The three-year operating record for the period January 1984 to December 1986 which has been compiled for this optimization study, is presented in Appendix C, Tables 1.0 through 7.0 inclusive.

A monthly summary of raw and treated water flows for the last three consecutive years is presented in Table 1.0. This table tabulates monthly daily averages, as well as daily maximum and minimum flows in ML/d.

Daily raw and treated water flows are tabulated in Table 1.1. Separate tables are provided for each year of the three-year record. Flow data presented include monthly daily averages, and daily minimums and maximums. Raw water represents the total daily flow taken into the plant, while treated water represents the total daily amount of water pumped into the distribution system.

A particulate removal profile for the plant is presented in Tables 2.0 and 2.1 inclusively. Table 2.1 presents average daily values of turbidity for raw, settled, filtered and treated water as well as average daily coagulant dosages, raw and treated water pH, raw water temperature, and, weekly, results for aluminum in the raw and treated water. Table 2.0 presents a yearly summary of maximum, minimum, and average values for the particulate removal parameters given in Table 2.1.

The practice of disinfection is covered by Table Nos. 3.0, 3.1, and 3.2. Monthly summaries for 1984 to 1986 are given in Table 3.0 and 3.1. These tables present monthly average, maximum and minimum values for pre- and post chlorination dosages, as well as the free and total chlorine residuals of the treated water.

A monthly summary of average, maximum and minimum values for carbon and fluoride for the three year record is given in Table 4.0. In addition, the table documents the fluoride residual of the treated water. A daily taste and odour control, and fluoridation profile are given in Table 4.1 for the years 1984 to 1986.

A record of the general chemistry and bacterial water quality is given in Table 5.0. Tests are carried out at the MOE lab in Toronto and London, Ontario, and include:

- general chemical parameters
- metals - aluminum, and one single analysis in 1984 for arsenic, barium, cadmium, copper, lead, manganese, nickel, silver, selenium and zinc
- purgeable organics
- bacteria - total coliform, total coliform background, fecal coliform and standard plate count..

A three-year summary of raw and treated water quality is presented in Table 5.1. This table includes all the parameters of Table 5.0 but tabulates yearly average, maximum and minimum values.

Algae analyses were carried out on two raw water samples per month during the period January to September 1984 at the MOE lab in Toronto. Results of these analyses are presented in Table 6.0.

A monthly summary of the bacteriological test results for 1984 to 1986 is given in Table 7.0.

D.6.2 PROCESS AND QUALITY CONTROL

The plant operator is responsible for maintaining the Daily Log Sheet and the Daily Lab Report. Data are recorded for every hour of the 24-hour day and include information on flows, chemical treatment and quality control testing. At the end of the day the information is summarized and daily maximum, minimum and average values are recorded. Specific entries of the above forms include the following:

a) Flows

- raw water flow to pretreatment basins (summated flow signal for two individual flow meters)
- summated filtered water flow (based on individual filter flow meters)
- backwash water flow
- service water used at the plant including filter surface wash
- summated plant output - total flow pumped to the distribution system.

b) Chemical Treatment

- liquid alum	. consumption in kg/d, based on totalizer readings for the Rotodip feeder transmissions
- carbon	. consumption in kg/d, based on totalizer readings for the Rotodip feeder transmissions
- chlorine	. consumption in kg/d for prechlorination and postchlorination combined . weight is obtained from loss-of-weight scale in chlorine storage room . calculated dosage for each chlorination mode
- fluoride	. sodium silicofluoride consumption in kg/d, based on loss-of-weight recorder reading . calculated daily fluoride dosage

c) Quality Control Testing

The following analyses are carried out at the water treatment plant:

- turbidity
  - six times per day using a Hach, Model 1860A, bench-top turbidimeter for raw, settled, filtered water conduit effluent and plant effluent
- temperature & pH
  - daily, raw and treated water
- odour
  - several times per day, raw and settled water
- chlorine residual
  - six times per day using a Hach dr/2 spectrophotometer
  - total Cl_2 residual on filtered effluent and total and free Cl_2 residual on final effluent
- fluoride residual
  - daily with spectrophotometer, treated water
- aluminum
  - weekly with spectrophotometer

Samples for above analyses are obtained in the lab from the appropriate sample tap (described in Section C.5).

D.6.3 WATER QUALITY EXAMINATION

Water quality analyses for various chemical, biological and bacteriological parameters are carried out routinely at the Ministry of the Environment laboratories. Parameters that have been analyzed for and the frequency of the analyses are as follows:

- bacteriological analyses
  - at MOE lab in London
  - raw water: Mondays and Thursdays
  - treated water: Sundays, Mondays, Wednesdays and Thursdays
  - distribution system: once per week
  - booster station: two times per week
- algae
  - at MOE lab in Toronto
  - raw water: two samples per month (January to September 1984 only)

- general chemistry . once per month at MOE lab in Toronto
- THMs . once per month at MOE lab in Toronto

D.6.4 LABORATORY EQUIPMENT

Equipment available at the plant laboratory includes the following:

- 1- Hach, Model 1860A, Turbidimeter
- 1- Hach dr/2 Spectrophotometer
- 1- Corning, Model 109, pH meter
- 1 - Colour Comparitor
- 1 - Titration Cabinet
- 1 - Phipps & Bird Jar Test Apparatus

D.7 PROCESS AUTOMATION

The plant contains an analogue supervisory control system with telemetering capabilities between the Low Lift Pumping Station and the Treatment Plant, and between the Treatment Plant and the Centennial Avenue Reservoir.

The automatic control system, however, is no longer used and plant operations are controlled manually from the control room, except for the filters which are operated on a semi-automatic basis.

Automatic proportional-to-flow controls pace all chemical systems but dosages are selected and set manually.

D.8 DAILY OPERATOR DUTIES

The plant superintendent is responsible for the treatment process and all activities that take place at the plant. He holds a supervisory and staff management position and deals with matters relating to the public. His assistant is responsible primarily for plant maintenance and takes up the superintendent's duties in his absence.

Plant operators are responsible for the day-to-day running of the plant. A partial list of the major duties of the operators includes such activities as:

- keeping records of process operations, chemical treatment and quality control testing,
- checking operation of all equipment and responding to problems when they arise,
- initiating filter backwashing and observing operations,
- responding to and recording treatment upsets, equipment outages, unusual events such as cases of vandalism,
- carrying out water quality control tests and collecting water samples for analysis by outside laboratory,
- confirming accuracy of on-line monitors - turbidity, chlorine residuals,
- confirming flow rate accuracy of liquid chemical metering equipment and chlorinators,
- receiving chemical deliveries and ensuring adequacy of supplies,
- exercising standby mechanical equipment,
- responding to alarm conditions.

In addition to the physical tasks listed above, operators must stay in constant communication with the plant superintendent and his assistant.

SECTION E

PLANT PERFORMANCE

SECTION E - PLANT PERFORMANCE

E.1 GENERAL OVERVIEW

Plant operations and performance at the St. Thomas plant were discussed with the senior operator, Mr. J. Apfelbeck, who has been at the plant since start-up. No significant operating problems were reported and plant performance indeed is at a high level. This excellent achievement has been continuous over the years with only one-half of the plant's pretreatment units in operation at any one time because of low production requirements. The use of treatment units is alternated relative to the timing for manual clean-out of the sedimentation basins.

No significant water problems, either at the plant or in the distribution system, have been reported. The primary objectives for water treatment are consistently being achieved in spite of the rapid changes in turbidity levels in the raw water which have exceeded values of 300 Ftu. The only problem of some concern relates to taste and odours which occasionally have passed through into the distribution system. Odours to a minor degree exist all the time but are particularly noticeable during the algae growing season. Odours are being controlled by the addition of powdered activated carbon during coagulation. From experience operators have learned that to control odours, it is necessary to overdose initially when a change in odour level is detected and then to trim back slowly to the minimum required carbon dosage.

E.2 TURBIDITY

E.2.1 EVALUATION OF PARTICULATE REMOVAL EFFICIENCY

a) Raw Water Quality

Operating records for particulate removal at the St. Thomas (Elgin Area) Water Treatment Plant are presented in Tables 2.0 and 2.1 of Appendix D. Table 2.0 presents a monthly summary of the average,

maximum and minimum raw and treated water turbidity values for 1984 to 1986. In addition, corresponding values are tabulated for i) primary coagulant, ii) aluminum residual in the raw and treated water, iii) raw and treated water pH, and iv) raw water temperature. Table 2.1 presents daily values for the same parameters given in Table 2.0 and covers the same period of record.

At St. Thomas, particulate removal from the source water is achieved by sedimentation and filtration. Processes are optimized by the addition of alum in the rapid mix tank and by tapered flocculation of the coagulated water prior to sedimentation. The objective is to produce the highest achievable water clarity in the finished water, equal to or less than 0.2 FTU turbidity, with the least amount of alum addition under any of the occurring raw water turbidity conditions.

The raw water turbidity in Lake Erie is highly variable. This will be evident from Figure E.1 which presents graphs of the monthly daily maximum, minimum and average turbidity values for the three-year period of record. It will be noted that the poorest water quality with respect to turbidity occurs in the spring during March, April and May, and in late summer and fall during September, October, November and December. Maximum monthly high values range from about 150 to over 400 FTU.

Average monthly turbidity levels range from about 10 to 90 FTU. In Figure E.2 included hereafter, turbidity frequency curves are presented for monthly maximum and average values. These curves illustrate the per cent of time a given value of turbidity within the data range was exceeded during the three year period of record. For example, the daily average monthly turbidity value of 15 FTU was exceeded 83 per cent of the time, whereas the monthly maximum of 100 FTU was exceeded 50 per cent of the time.

An analysis of the frequency of occurrence of the average monthly turbidity levels is given in Table E.1 following. This table was derived from the graph of Figure E.2 and further illustrates the

TABLE E.1

RAW WATER QUALITY - TURBIDITY AND FREQUENCY

1984 to 1986

Turbidity [1] FTU	Frequency of Occurrence per cent time	Duration Jan. 84 - Dec. 86, days
Under 5	<3	33
5-10	5.8	614
10-20	23.6	258
20-30	29.4	322
Over 30	38.2	418
	100.0	1095

[1] Average monthly raw water turbidity.

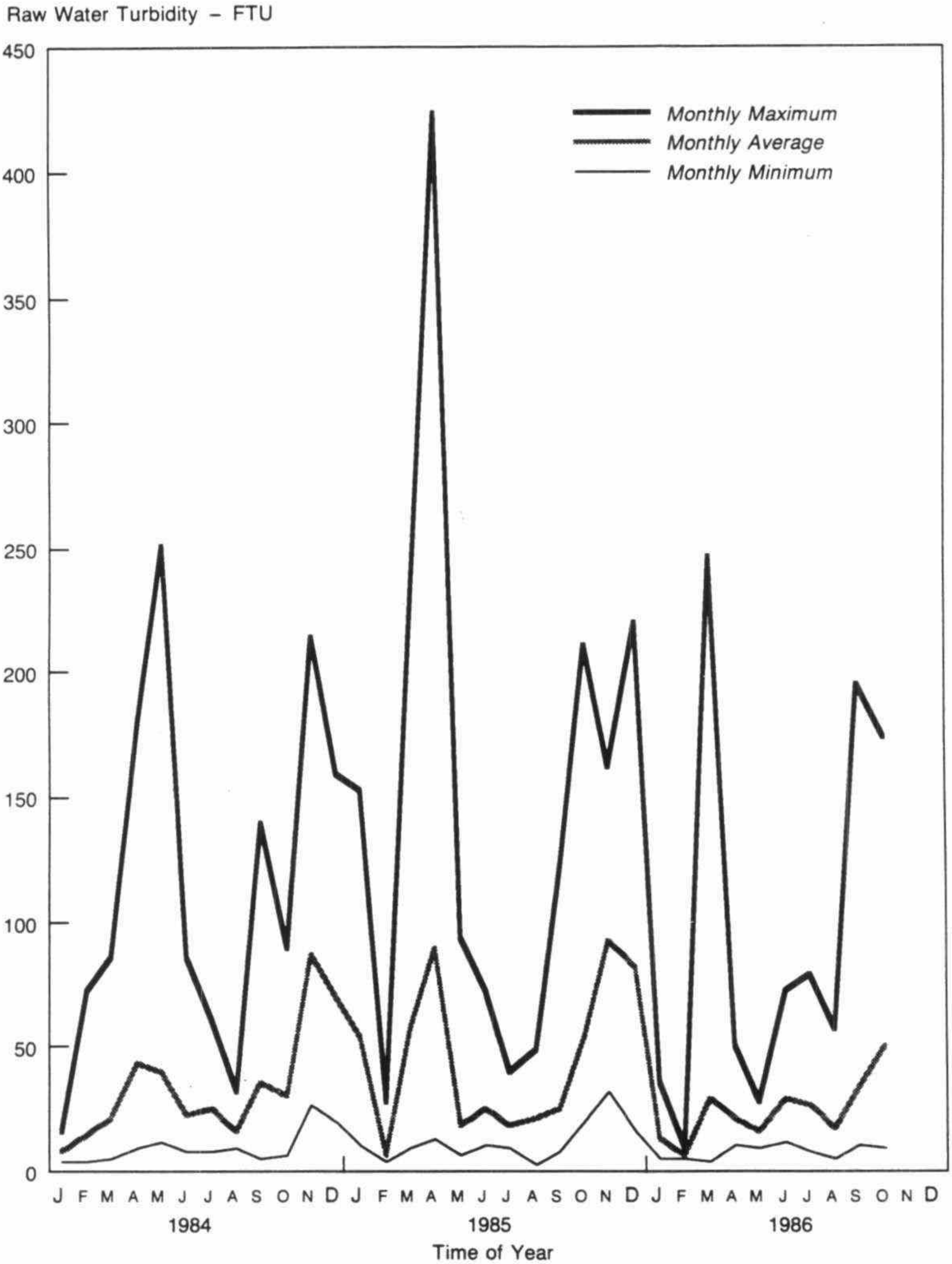


Figure E.1
ST. THOMAS WATER TREATMENT PLANT
Raw Water Turbidity - 1984 to 1986

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high levels of raw water turbidity that exist almost all of the time.

By scanning the operating data in Table 2.1, it will be evident that the durations of high turbidities, in the order of 150 FTU and higher, can last from two to four days and longer. The tabulation of specific high raw water turbidity events presented in Table E.2 following will serve to illustrate this point. High levels of turbidity for long durations impose high solids loadings on treatment units which, if overloaded hydraulically, will result in poor settled water quality and a high carry-over of solids to the filters. This can lead to operating difficulties with the filters consisting of short filter runs and/or turbidity breakthrough. Fortunately, at St. Thomas this is not the case since adequate treatment capacity exists in both sedimentation and filtration units. Also, peak water demands occur during June, July and August and do not coincide with the occurrence of high raw water turbidities. This means that during high turbidity periods treatment units are operating at lower flow rates which minimizes the potential adverse impact on treatment performance due to high solids loadings. Operating records reviewed for the plant confirm the production of a high quality effluent without any impairment in filter effluent turbidity, even during adverse raw water quality conditions. This will be discussed further in the next section.

b) Particulate Removal

The graph shown in Figure E.3 was developed by plant operations from jar-tests and correlates optimum alum dosages for various levels of raw water turbidity. It is used as a guide in setting the Rotodip feeder feed rates for alum addition during plant operations. Operators adjust feed rates manually in accordance with changes in raw water turbidity, temperature of the raw water, and the level of the filtered effluent turbidity.

The actual alum dosage applied during the study period is shown graphically in Figure E.4 for monthly average and monthly maximum

raw water turbidity levels. Although there is considerable scatter in data points, applied alum dosages, on the average, tend to follow the optimum dosage guide of Figure E.3.

A performance curve for the sedimentation basins is given in Figure E.5. This figure presents a plot of monthly average raw water turbidity versus settled water turbidity. The highest average monthly settled water turbidity experienced over the three-year study period was 9.0 FTU and corresponds to an average monthly raw water turbidity of 90 FTU. This represents an efficiency of particulate removal of 90 per cent. With lower raw water turbidity levels the efficiency of removal in the sedimentation tanks decreases to a low of 80 per cent. These results are indicative of good to excellent removal of particulate matter in the sedimentation basins which can be attributed to a combination of efficient coagulation and flocculation and low overflow rates. This conclusion is confirmed by the operating data in Table E.3 included herewith in which sedimentation tank and filter performance records are tabulated for periods of high raw water turbidities in 1984 to 1986. In reference to the data for November of 1984, it will be noted that raw water turbidities ranged from 47.0 to 214 FTU, but settled water turbidities only varied from 5.4 to 10.0 FTU. These low settled water turbidities were achieved even for periods of high raw water turbidities (in the range of 100 to 200 FTU) which occurred on three occasions for two, three, and four consecutive days (4 and 5 Nov., 9, 10, 11, and 12 Nov., 15, 16 and 17 Nov.).

With the settling tank overflow rate averaging 0.99 m/h, which is about one-half the ultimate design rate, such high performance is to be expected. Similar comments apply to data for other periods of high turbidity shown in Table E.3

Filter effluent turbidity varied from 0.11 to 0.17 FTU; the average was 0.14 FTU. These are excellent results and represent a very high standard of performance for dual-media, gravity filters. These results reflect the high degree of pretreatment achieved

TABLE E.2

HIGH RAW WATER TURBIDITY EVENTS

1984 - 1986

1986	Turbidity (FTU)
Mar. 28	46.3
29	191.0
30	246.2
31	95.0
Sep. 10	16.0
11	122.0
12	195.0
13	49.3
Oct. 10	57.8
11	136.5
12	174.7
13	94.0
Dec. 01	84.3
02	96.5
03	223.0
04	167.0
05	156.0
06	159.7
07	132.2
08	91.2

1985	Turbidity (FTU)
Mar. 26	58.3
27	103.8
28	224.0
29	123.0
30	78.8
31	60.3
Apr. 01	424.0
02	263.0
03	206.0
04	125.0
05	127.0
06	215.0
07	195.8
08	97.3
Nov. 18	75.0
19	114.5
20	128.0
21	115.5
22	143.6
23	144.0
24	78.2
Dec. 01	50.0
02	219.2
03	199.2
04	80.2

1984	Turbidity (FTU)
Apr. 29	15.5
30	180.0
May 01	251.0
02	73.3
Nov. 03	47.0
04	151.8
05	163.4
06	62.3
07	58.0
08	76.7
09	148.0
10	138.0
11	133.0
12	133.0
13	93.0
14	64.1
15	214.0
16	194.0
17	104.0
18	59.3

TABLE E.3

PARTICULATE REMOVAL OPERATING DATA

PERIODS OF HIGH RAW WATER TURBIDITY - 1984 to 1986

1986	Avr. Day Turbidity, FTU Raw	Settled	Filtered	Alum mg/L	Flow ML/d	Sed. Tank O/R, m/h	Filter Rate, m/h
Mar. 27	33.7	6.3	0.11	24.0	25.99	1.12	5.28
28	46.3	7.2	0.08	23.9	24.19	1.04	5.20
29	191.0	9.6	0.07	44.6	24.18	1.04	5.19
30	246.2	12.6	0.08	51.9	22.63	0.98	4.86
31	95.0	8.9	0.04	30.5	21.68	0.94	4.66
Sept. 9	17.5	3.8	0.10	12.2	30.22	1.31	6.49
10	16.0	3.6	0.10	12.0	26.50	1.14	5.69
11	122.0	3.9	0.10	29.6	26.30	1.14	5.65
12	195.0	4.5	0.08	36.7	31.30	1.35	6.72
13	49.3	3.9	0.07	19.5	22.27	0.96	4.78
14	27.3	3.6	0.07	16.3	23.16	1.00	4.97
Oct. 9	96.8	5.6	0.07	24.5	32.89	1.42	7.06
10	57.8	7.4	0.09	16.7	26.13	1.13	5.61
11	136.5	7.8	0.11	24.5	24.37	1.05	5.23
12	174.7	6.2	0.10	27.8	19.57	0.85	4.20
13	94.0	4.3	0.07	28.4	20.10	0.87	4.32
14	51.2	4.5	0.08	26.1	25.33	1.09	5.44
Dec. 1	84.3	7.8	0.08	24.0	26.50	1.14	5.69
2	96.5	7.3	0.08	25.7	27.22	1.18	5.85
3	223.0	7.3	0.09	33.1	26.56	1.15	5.70
4	167.0	8.5	0.07	28.7	28.02	1.21	6.02
5	156.0	9.3	0.10	28.0	25.05	1.08	5.37
6	159.7	8.6	0.08	29.7	24.04	1.04	5.16
7	132.2	7.4	0.07	28.2	23.68	1.02	5.09
8	91.2	7.1	0.07	24.0	21.60	0.93	4.64

1985	Avr. Day Turbidity, FTU Raw	Settled	Filtered	Alum mg/L	Flow ML/d	Sed. Tank O/R, m/h	Filter Rate, m/h
Mar. 24	52.3	9.4	0.19	25.6	16.70	0.72	3.59
25	56.7	8.4	0.41	27.1	23.68	1.02	5.09
26	58.3	11.3	0.62	23.7	24.62	1.06	5.29
27	103.8	11.7	0.14	25.6	23.09	1.00	4.96
28	224.0	16.0	0.27	47.5	25.03	1.08	5.38
29	123.0	12.9	0.36	38.8	25.07	1.08	5.38
30	78.8	11.0	0.22	34.5	23.70	1.02	5.09
31	60.3	7.2	0.18	31.8	17.34	0.75	3.72
Apr. 1	424.0	14.0	0.21	68.6	24.33	1.05	5.23
2	263.0	12.0	0.12	61.7	22.92	0.99	4.92
3	206.0	11.8	0.17	52.8	24.96	1.08	5.36
4	125.0	9.6	0.28	42.1	24.84	1.07	5.34
5	127.0	10.2	0.12	44.5	23.31	1.01	5.01
6	215.0	11.8	0.12	52.8	14.47	0.62	3.11
7	195.8	10.1	0.14	51.5	17.37	0.75	3.73
8	97.3	8.9	0.19	39.2	25.49	1.10	5.47
Nov. 18	75.0	9.3	0.11	19.7	26.39	1.14	5.67
19	114.5	8.0	0.10	24.8	25.38	1.10	5.45
20	128.0	8.1	0.08	25.3	25.36	1.10	5.47
21	115.5	9.6	0.11	20.7	24.43	1.06	5.25
22	143.6	9.9	0.19	21.2	29.10	1.26	6.25
23	144.0	10.3	0.13	23.8	24.77	1.07	5.32
24	78.2	9.0	0.08	19.4	25.06	1.08	5.38
Dec. 1	50.0	8.6	0.10	17.5	20.08	0.87	4.31
2	219.2	9.8	0.10	34.3	25.19	1.09	5.41
3	199.2	9.4	0.13	30.9	25.16	1.09	5.40
4	80.2	10.0	0.17	21.5	25.44	1.10	5.46
5	67.2	9.8	0.11	18.7	24.67	1.07	5.30

1984	Avr. Day Turbidity, FTU Raw	Settled	Filtered	Alum mg/L	Flow ML/d	Sed. Tank O/R, m/h	Filter Rate, m/h
Apr. 29	15.5	5.5	0.16	11.0	21.84	0.94	4.69
20	180.0	7.2	0.16	27.2	23.63	1.02	5.08
May 1	251.0	8.3	0.14	40.5	23.09	1.00	4.96
2	73.3	6.1	0.11	23.2	21.77	0.94	4.68
3	56.8	6.3	0.16	23.1	23.84	1.03	5.12
Nov. 1	86.7	5.4	.13	18.1	24.65	1.06	5.29
2	143.3	7.6	.11	23.0	23.40	1.01	5.03
3	47.0	7.5	.14	12.4	23.50	1.01	5.05
4	151.8	8.4	.13	22.6	22.70	0.98	4.88
5	163.4	8.6	.11	22.8	20.80	0.90	4.47
6	62.3	8.0	.14	16.3	22.65	0.98	4.86
7	58.0	8.7	.13	15.5	24.65	1.06	5.29
8	76.7	9.0	.13	18.9	25.81	1.11	5.54
9	148.0	8.1	.10	24.7	26.33	1.14	5.66
10	138.0	6.6	.12	21.3	16.75	0.72	3.60
11	133.0	7.5	.13	24.2	20.61	0.89	4.43
12	133.0	7.8	.10	24.7	22.85	0.99	4.91
13	93.0	7.8	.11	19.6	22.21	0.96	4.77
14	64.1	8.9	.12	17.0	28.19	1.22	6.05
15	214.0	10.0	.17	23.4	24.05	1.04	5.17
16	194.0	8.0	.14	21.4	22.10	0.95	4.75
17	104.0	8.6	.14	16.1	23.37	1.01	5.02
18	59.3	7.5	.14	7.9	18.93	0.82	4.07

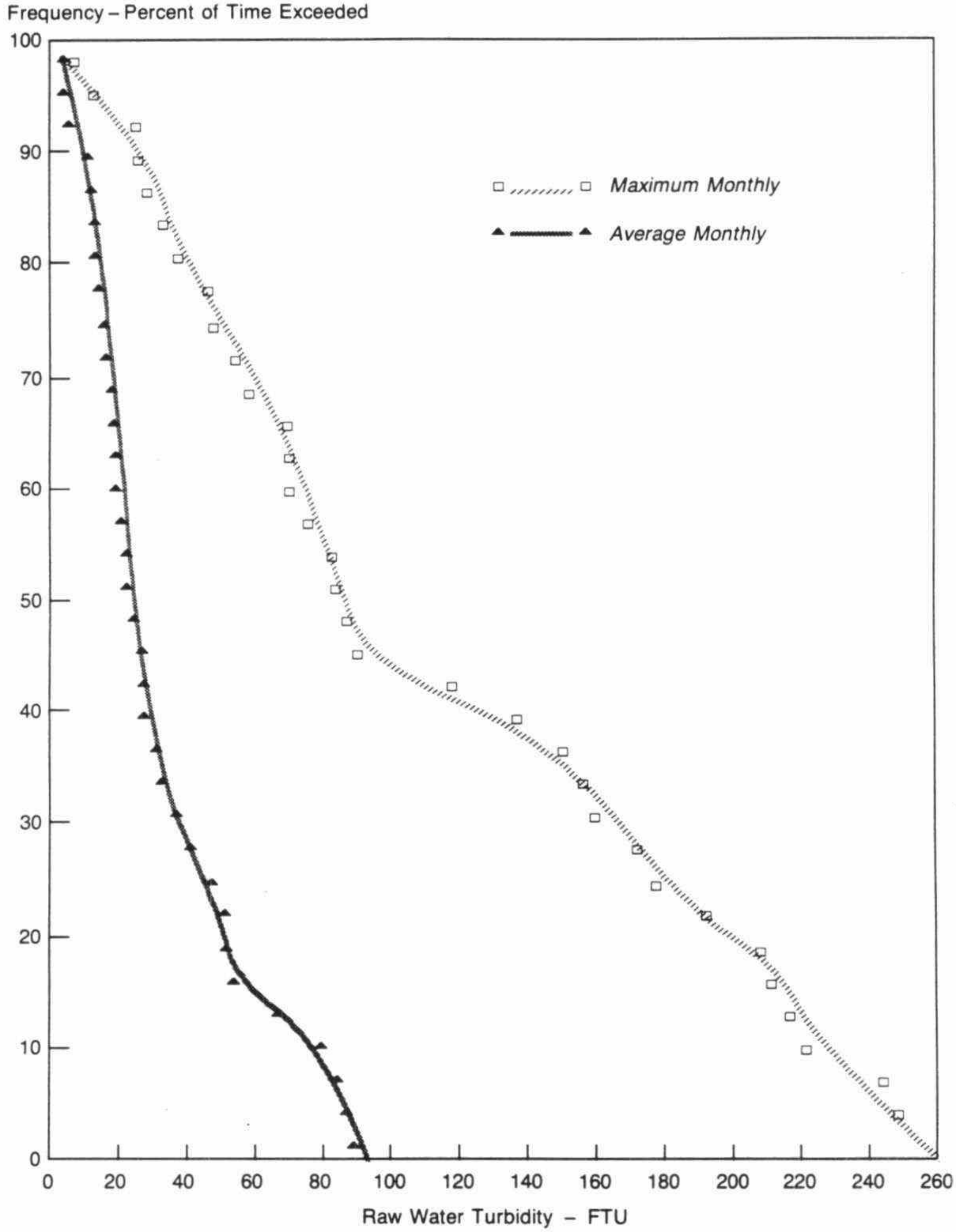

Figure E.2
ST. THOMAS WATER TREATMENT PLANT
Turbidity Frequency Curves – 1984 to 1986

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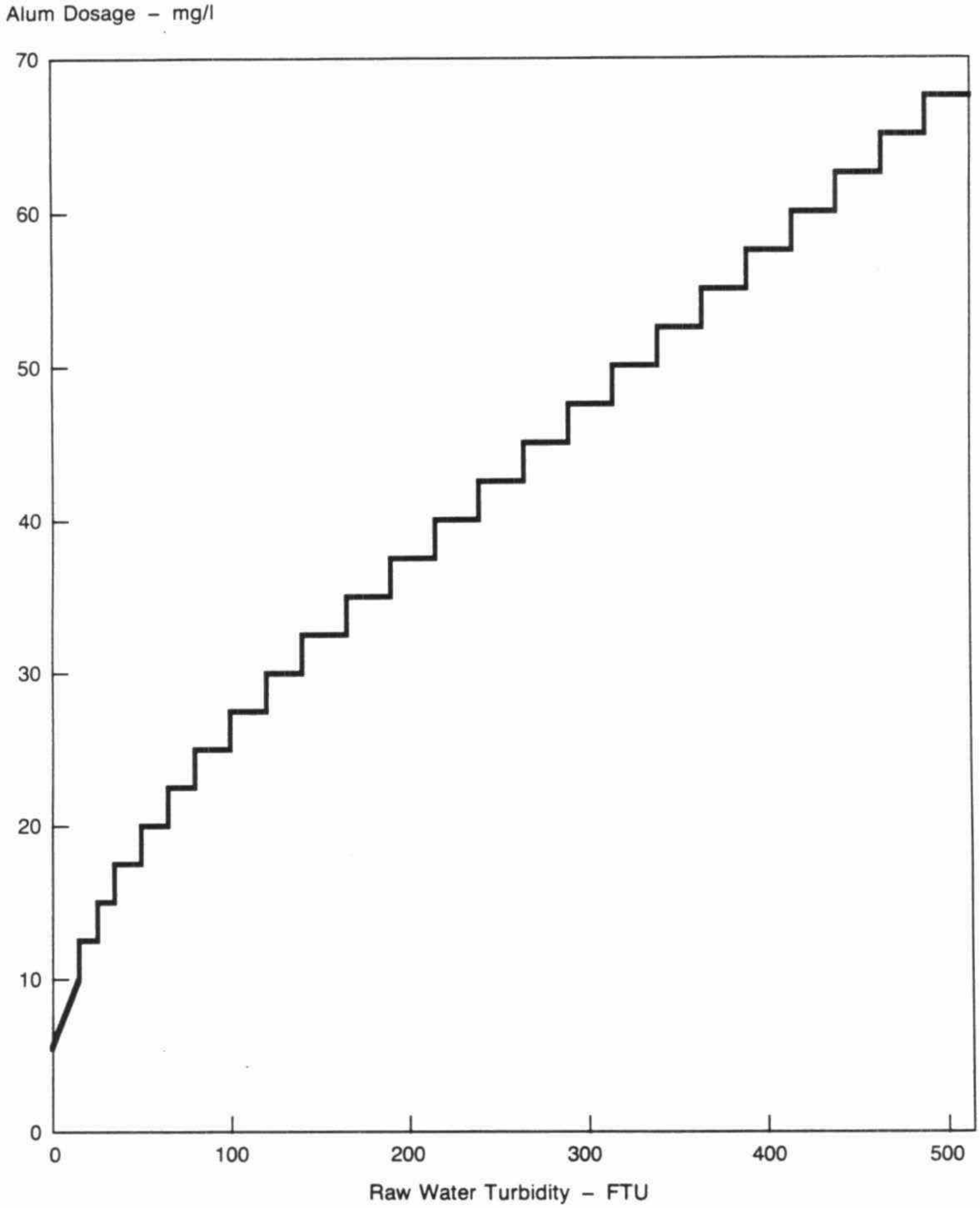

Figure E.3
ST. THOMAS WATER TREATMENT PLANT
Alum Dosage versus Raw Water Turbidity

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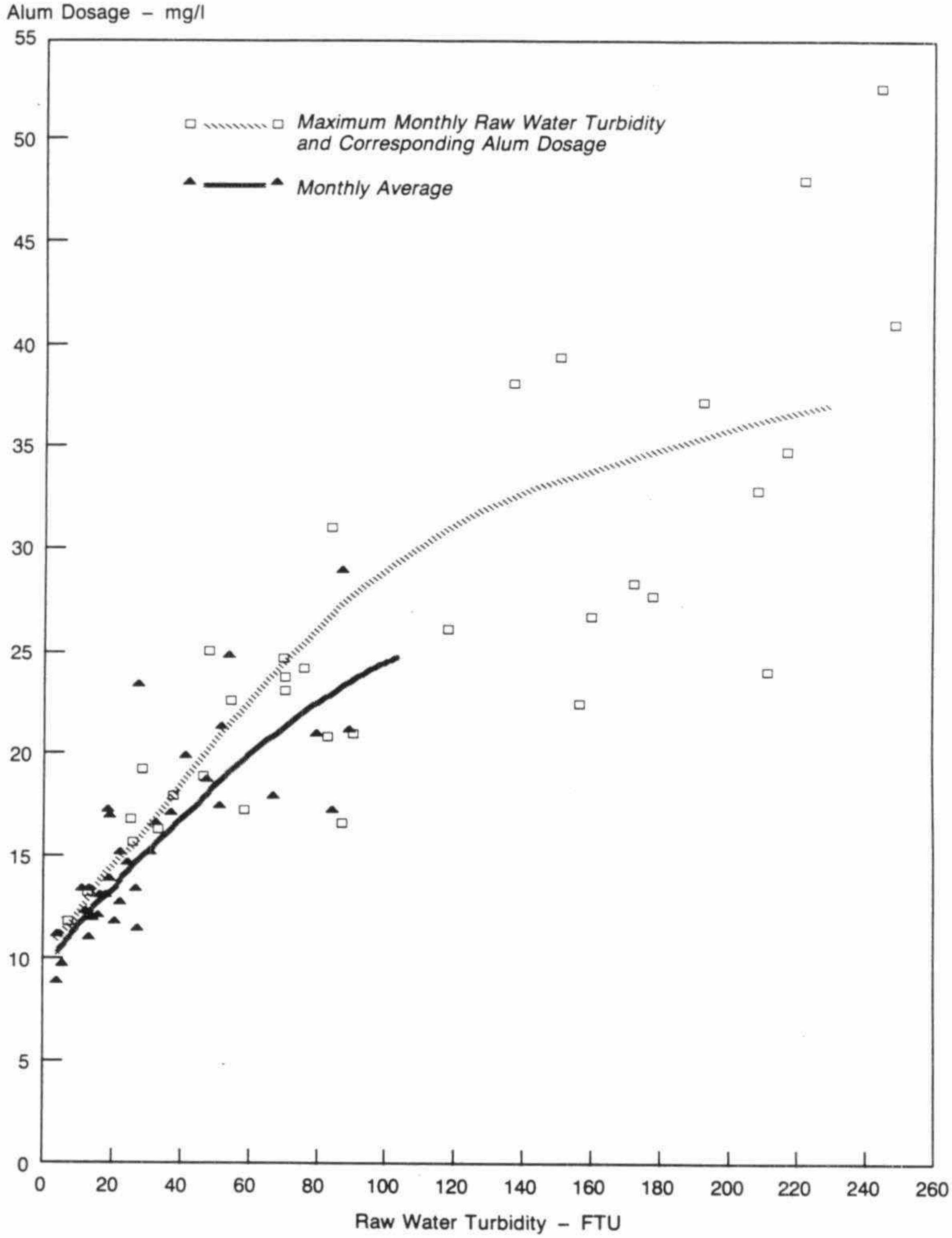

Figure E.4

ST. THOMAS WATER TREATMENT PLANT

Correlation of Alum Dosage Applied and Raw Water Turbidity - 1984 to 1986

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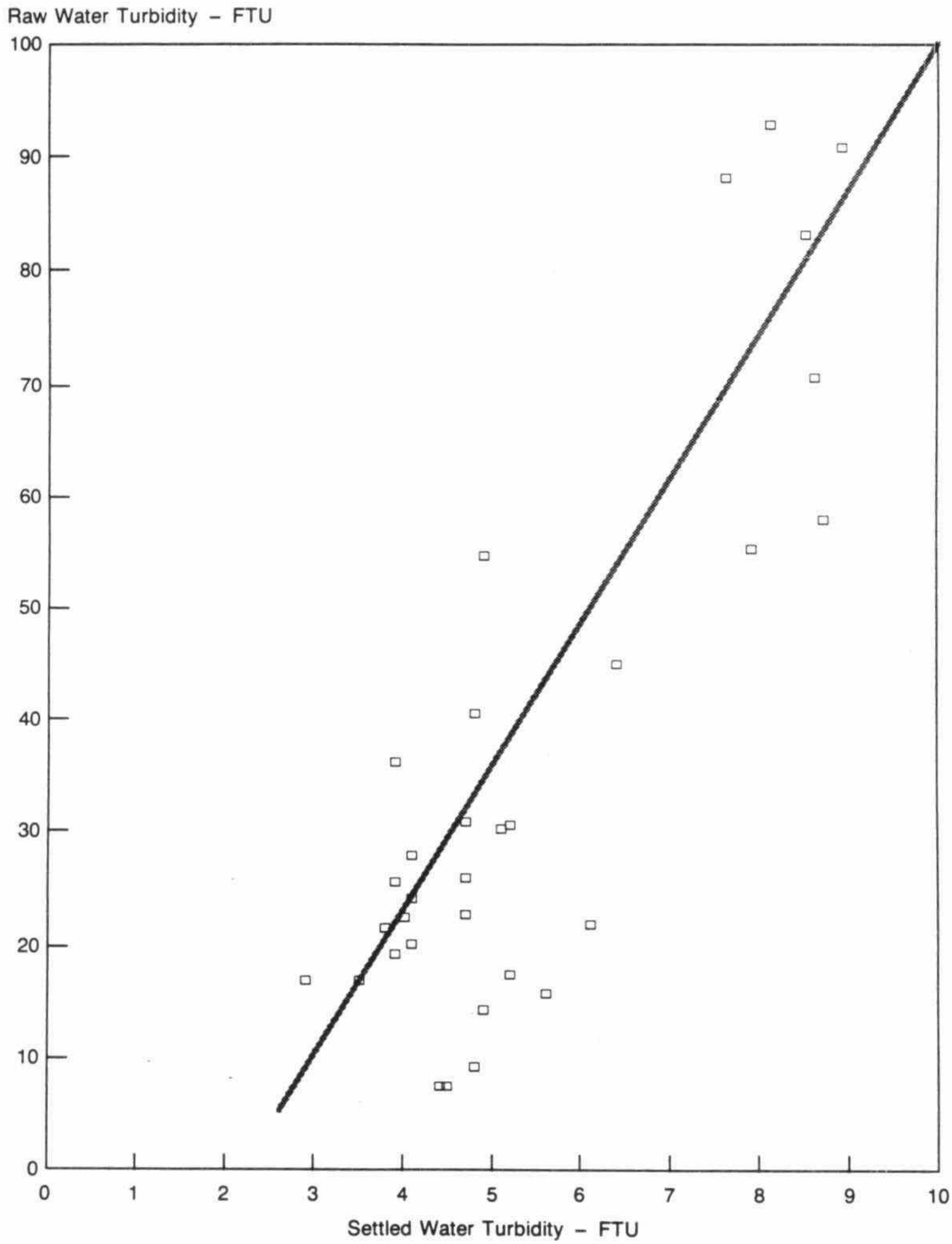

Figure E.5
ST. THOMAS WATER TREATMENT PLANT
Monthly Average Raw Water Turbidity versus Settled Water Turbidity

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through coagulation and flocculation and, partly, are also due to very low filter rates which averaged 4.94 m/h. This rate is less than one-half the accepted design objective of 11.7 m/h for dual-media, high rate filters. The alum dosages applied, in our opinion, were the main reason for achieving such a high level and uniform filter performance. These dosages are suspected to be at or near optimum levels in view of the low effluent turbidity that was achieved and because no filter breakthrough occurred prior to reaching terminal head loss.

The length of filter runs is affected more by the level of plankton in the raw water than by turbidity. This is evident from the operating record which shows that three filters were in use during periods in the year when plankton is present at elevated levels.

E.2.2 OPTIMUM PERFORMANCE ALTERNATIVES

As is evident from the existing operational record reviewed in the previous section, the St. Thomas plant requires little, if any, improvement in the removal of particulate matter. Nevertheless, we have evaluated alternatives that might further improve the removal of turbidity on a continuous basis. Alternatives that were evaluated include the following:

1) Automatic Control of Alum Dosage

We have considered the use of a Streaming Current Detector (S.C.D.) for automatic control of alum dosages. The S.C.D. can measure the optimum alum dosage, relative to a predetermined set point and is, therefore, of value in tracking optimum dosage relative to changes in raw water quality. The S.C.D. output signal can also be used as the process variable for automatic control of the dosage setting on the chemical feeder. Benefits from the use of this instrument would result from (i) immediate response to requirements for changing dosage which would eliminate over- and under-dosing, (ii) maintaining optimum conditions for coagulation, which should be reflected by the quality and consis-

tency of the filter effluent, and (iii) an overall reduction in coagulant consumption which would lower operating costs for chemicals.

The Omega Rotodip chemical feeders in use at the St. Thomas plant, are currently not suitable for automatic dosage adjustment but can be modified for qualitative automatic control.

2) Flocculant Aid

The use of a polyelectrolyte as a flocculant aid should be considered in order to reduce alum consumption and the amount of alum sludge that is produced. An improvement in treatment may also result due to the formation of a faster settling floc with better filtering characteristics.

The aluminum residual in the treated water, however, may not be affected since the level of dissolved aluminum is pH dependent.

3) Filter Operation

Filters operate under low filter rates compared with the design rate (6.6 m/h max. vs. 9.77 m/h design).

Rate controllers are designed to open slowly on filter start-up.

In order to optimize the performance of the filters, it is suggested that filters be allowed to rest for about 15 minutes after a wash before placing the filter back in service. This would permit the filter media to consolidate and, therefore, reduce the high initial effluent turbidity that normally occurs at the start of a filter run immediately following a backwash.

Other means of reducing initial filter breakthrough should be investigated. These include:

1. conditioning the media with a polymer near the end of a backwash,

2. modifying filter effluent piping to permit filtering to drain at the start of a filter run.

Although spare treatment plant capacity is available, running both sedimentation tanks and all four filters all the time is not warranted in view of the excellent effluent quality that is being produced with one-half of the plant's processing units. The practice of bringing on additional filters during the summer when the level of plankton in the raw water is high should be continued.

4) Treatability Test

Future testing should be initiated by plant management in order to evaluate 1) the effectiveness of an alternate primary coagulant such as polyaluminum chloride, and 2) the effectiveness and economic benefits associated with the use of polyelectrolyte flocculant aids.

E.2.3 CAPABILITY OF EXISTING PLANT

The worst raw water quality conditions during the three-year study period occurred on April 1, 1985, as indicated in Table E.3. On this day the raw water turbidity averaged 424 FTU. This day was preceded by two days of moderately high turbidity in the range of 60 to 80 FTU. On April 2 and 3, the average turbidity was 263 and 206 FTU respectively. The downward trend continued on April 4 and 5 reducing turbidity to 125 and 127 FTU respectively but levels increased again to 215 and 195 FTU over the following two days. During the high turbidity period between April 1 to 7, settled water turbidity varied from 9.6 FTU to 14 FTU and averaged 11.6 FTU. The high level of 14 FTU was established on April 1 when the raw water turbidity was at its highest level of 424 FTU. On the basis of these numbers, settling tank performance was 96.7 per cent, which, indeed, represents a very high degree of solids removal. One might ask why on April 4, with a raw water turbidity of 125 FTU, the settled water turbidity was 9.6 FTU which represents a solids removal efficiency of 92.3 per cent. On both days sedimentation tank overflow rates and filter flow rates were similar in magnitude and the difference in performance cannot be attributed to a difference in hydraulic loading rates. Further, it is not an isolated case as will be evident from the plot in Figure E.5 which shows that settling tanks perform better at higher raw water turbidities within the operating range experienced at St. Thomas.

One explanation for this phenomenon may be that coagulation and flocculation processes at the optimum alum dosages, are more efficient at higher solids levels in the mixing zones. Also, the size distribution of particles for high raw water turbidity may be such that the bulk of the particles settle more readily than those associated with low water turbidity.

In any event, during this period of adverse raw water quality, the treatment plant was able to continue producing a high clarity effluent from the filters - filtered water turbidity ranged from 0.12 to 0.28 FTU and the average for the week was 0.17 FTU. The average length of filter runs was 73 hours. These results confirm our previous conclusions that the St. Thomas plant is capable of producing drinking

water of very high clarity even under the worst raw water turbidity conditions experienced during 1984 to 1986.

E.2.4 REQUIREMENTS FOR OPTIMUM PERFORMANCE ALTERNATIVES

Several alternatives for optimizing treatment plant performance were identified in Section E.2.2 above. Of these alternatives, those considered most feasible are presented below in order of priority.

Alternative 1

The continuous production of a high clarity filtered water at St. Thomas may be possible by improving filter operations.

The objective is to reduce or eliminate the initial filter breakthrough which occurs immediately following filter backwashing. This can be achieved, in part, by letting a filter rest for about 15 minutes after a wash before returning the filter to service. The assumption here is that during the rest period the filter media will compact and return to similar conditions it was in before backwashing. If this is so, then the filter should produce water with low turbidity immediately following start-up.

However, breakthrough of turbidity may still occur due to the hydraulic surge that occurs during a sudden start-up of a filter. At St. Thomas, this problem has been reduced by slowly opening the filter rate controllers.

The foregoing filter operating procedure would be very simple to implement at virtually no cost to the project. What needs to be established is whether the duty filter(s) will be able to sustain the additional hydraulic load without deterioration in effluent quality for the extended time that the filter being washed is out of service.

Alternative 2

An alternative method for reducing the initial filter breakthrough after a wash cycle is to condition the filter media using a polymer. The polymer would be applied to the wash water near the end of the backwash cycle. As an example, this procedure of filter conditioning is currently being used at the Toronto Island Filtration Plant with some degree of success.

Implementation of this alternative will require the provision of a polymer feed system capable of applying up to 3 mg/L of a non-ionic polymer to the filter backwash water.

Alternative 3

A third alternative for reducing initial filter breakthrough after start-up is to filter to drain. Although simple in concept, this alternative would be difficult to implement at the St. Thomas Treatment Plant. Filter effluent piping would require the addition of filter to drain piping equipped with automatically controlled valves. The feasibility of filtering to drain should be established by full-scale testing. This can be done at lower filter rates using the manually controlled filter drain pipe.

As for Alternative 1, this option increases the time a filter being backwashed is out of service which may affect effluent quality from the duty filter(s). In addition, the wash water consumption would increase by up to 20 per cent.

Alternative 4

This alternative is aimed at reducing the amount of filter backwash water used by stopping the wash water cycle automatically based on a predetermined level of turbidity in the wash water.

The Hach Company is now marketing a backwash water turbidity meter specially designed for measuring the high turbidities in the wash water.

E.3 DISINFECTION

E.3.1 EVALUATION OF EFFECTIVENESS OF THE DISINFECTION PROCESS

The objective at St. Thomas regarding chlorination for disinfection is to maintain a total chlorine residual of 0.9 to 1.0 mg/L in the treated water leaving the plant.

a) Chlorination Hardware

The plant includes a separate chlorine building equipped with the following chlorination facilities:

- three Wallace and Tiernan gas chlorinators; one pre-, one post-chlorinator, and one standby unit. The spare chlorinator serves as standby to either the pre- or post-chlorinator - capacity is adjustable by rotameter selection;

- one Wallace and Tiernan chlorine residual analyzer for monitoring of total chlorine residual in plant output;

- one chlorine control panel installed adjacent to the analyzer in the chlorine equipment room (Photograph 8);

- separate chlorine storage room for ton containers;

- one 3-ton container scale;

- fifteen additional 1-ton containers in storage.

b) Application Points

Chlorine solution is applied after sedimentation in the settled water conduit (prechlorination) and in the high lift pump suction conduit (postchlorination).

Prechlorination after sedimentation serves two purposes; namely,

1) reduce chlorine consumption by powdered activated carbon which is applied in the rapid mix tank(s) for control of taste and odour;

2) eliminate production of trihalomethanes in the pretreatment process - during flocculation and sedimentation.

c) Dosages and Control

A record of the disinfection practice at the plant is presented in Tables 3.0, 3.1, 3.2, 5.0 and 5.1 of Appendix C.

Table E.4 following presents a 3-year summary of chlorine dosages applied and resultant chlorine residuals. On average, the prechlorine dosage varied from about 1.3 mg/L to 1.5 mg/L; and the postchlorine dosage was about 0.35 mg/L. The range of prechlorination dosages experienced was from 0.76 mg/L to 2.90 mg/L. Applied dosages follow the chlorine demand which is relatively constant at moderate levels during the fall and spring seasons and somewhat variable at higher levels during the summer in view of the presence of algae in the raw water.

The range in postchlorine dosages was from 0.2 to 0.7 mg/L. Variations are due to changes in the chlorine demand and the plant's objective to maintain a total chlorine residual of 0.9 to 1.0 mg/L in the treated water pumped to distribution.

Dosage for pre- and postchlorination are set manually and automatically paced proportional to total treated water flow.

d) Chlorine Residuals

For prechlorination the total chlorine residual is monitored in the lab on samples of filtered water. The average residual value was 0.76 mg/L and varied from about 0.6 mg/L to 1.35 mg/L.

TABLE E.4

DISINFECTION - 3-YEAR SUMMARY

	1986		1985		1984	
	Pre	Post	Pre	Post	Pre	Post
Cl_2 Dosage:						
- Avg.	1.51	0.35	1.38	0.35	1.44	0.36
- Range	0.93-2.60	0.21-0.60	0.76-2.00	0.19-0.70	0.91-2.90	0.17-0.65
Free Cl_2 Residual						
- Avg.	-	0.77	-	0.76	-	0.80
- Range	-	0.54-0.93	-	0.54-1.04	-	0.63-1.01
Total Cl_2 Residual						
- Avg.	0.76	0.93	0.76	0.90	0.76	0.96
- Range	0.66-0.94	0.80-1.07	0.64-1.00	0.69-1.20	0.63-1.35	0.84-1.10

All units in mg/L

The total postchlorine residual is monitored and recorded on a continuous basis by an on-line automatic chlorine analyzer. For the operational record, postchlorine residuals, free and total, are determined in the lab on the plant output. The average free chlorine residual was 0.78 mg/L while the total was 0.93 mg/L. The range in total chlorine residuals for the entire period of record was 0.69 to 1.20 mg/L.

e) Process Evaluation

The prechlorine dose is selected to meet the plant's objective of maintaining 0.7 to 0.8 mg/L total chlorine residual in the filtered water. This practice is acceptable for the following reasons:

1) filter operations are improved, and

2) sufficiently high chlorine residuals are available for disinfection after filtration.

The loss in benefits associated with prechlorination ahead of pretreatment are, in this case, probably outweighed by the fact that no trihalomethanes are formed in the flocculation and sedimentation processes.

The clear well has a fixed storage volume of 3450 m^3 which ensures a minimum chlorine contact time of 1.8 hours after the filters based on the rated design capacity of the plant. Additional contact time is available in the variable storage capacity reservoir downstream of the clear well.

Postchlorination at the high lift suction conduit serves to establish the final chlorine residual in the water leaving the plant. A high chlorine residual is maintained because of the long lag times associated with transmission and distribution of the water to the consumers.

A few consumers relatively close to the plant are supplied directly from the transmission mains. For these consumers the chlorine residual is higher than what is desirable but no complaints regarding possible chlorinous taste and odour have been received by the plant staff.

Data on the bacterial water quality, raw and treated, have been recorded in Tables 5.0 and 5.1 of the operating protocol. A 3-year summary is presented in Table E.5 following this page. These data indicate an excellent record for disinfection at the plant. Of all the tests carried out each year on the treated water, only one test for total coliform organisms was positive in 1985 (August 7, 1985) and only two in 1986 (March 12 and 13, 1986); none of the tests for 1984 were positive. The density level for total coliform in the positive tests was 0-4 counts per 100 mL. On August 7, 1985, the total average chlorine residual in the treated water was 0.96 mg/L, and on March 12 and 13, 1986, values were 0.86 and 0.93 mg/L respectively. As can be seen, there were no problems with the chlorination systems nor chlorine residuals at the plant on those days, and the reasons for the adverse results are not apparent.

The efficiency of disinfection is primarily dependent upon the available concentration of free chlorine and contact time. But the former is pH and temperature dependent since chlorine in water hydrolyzes to form hypochlorous acid which dissociates and is in equilibrium with the hypochlorite ion. As pH increases, the hypochlorous acid concentration decreases, but increases slightly with cold water. At pH greater than 8.0 the hypochlorous acid concentration varies between 22% at 20°C to 30% at 0°C. At pH of 7.5 concentrations are 47% at 20°C and 58% at 0°C. Since the hypochlorite ion has virtually no disinfection capability, it is clear that the efficiency of disinfection can be improved for a given dosage of chlorine by operating at a raw water pH of about 7.5 rather than at 8.0 or above.

The raw water pH at the plant has an average value of about 7.75 during mid-May to mid-September. For the rest of the year the pH

TABLE E.5

BACTERIAL WATER QUALITY - 3-YEAR SUMMARY

	1986		1985		1984	
	No. of Samples	% Total Samples	No. of Samples	% Total Samples	No. of Samples	% Total Samples
Raw Water						
Total Coliform						
0-100/100 mL	65	94.2	96	93.2	98	95.1
101-5000/100 mL	4	5.8	7	6.8	5	4.9
Fecal Coliform						
0-10/100 mL	64	100	101	100	105	100
Treated Water						
Present/Absent Test						
Total Coliform A	132	98.5	200	99.5	203	100
P	2	1.5	1	0.5	0	0
TC Positive, 0-4/100 mL	2	-	1	-	-	-
Standard Plate Count						
MF <500/mL	35	100	34	100	20	95.2
>500/mL	0	0	0	0	1	4.8

is above 8.0 with an average value of 8.1 units. The maximum value recorded was 8.58 pH units. The addition of alum and chlorine reduces pH and the treated water pH generally was 0.6 pH units lower than the raw water pH.

Based on the above theory of chlorination, it can be concluded that disinfection can be improved, that is, a higher efficiency is possible with lower chlorine dosages, by lowering the raw water pH especially during the fall, winter and spring seasons when pH is very high. This can be achieved by adding an acid or by using acidified alum. The former approach is more complicated and involves handling a hazardous chemical. The use of acidified alum would not change existing operations and should be investigated as a feasible alternative to improve disinfection.

Plant operating data for total trihalomethanes are recorded in Tables 5.0 and 5.1. In the following table, Table E.6, a 3-year summary of all purgeable organics information on the treated water is presented. With reference to this table, it will be noted that the total trihalomethanes (TTHM) content, in the treated water had an average value of about 45 μg/L over the 3-year period. No significant change occurred from year to year. The range of minimum to maximum levels was 22 to 71 μg/L.

These results are relatively low in comparison with the current Ontario Drinking Water Objective of 350 μg/L. The operating levels of TTHM experienced are to be expected in view of the fact that:

1) DOC (dissolved organic carbon) levels in the raw water from Lake Erie are above average,

2) a higher than normal chlorine content is maintained in the clear well and reservoir, and

3) relatively long contact times are provided by the clear well and reservoir.

With regard to point 3) above, the retention times for the average day flow in 1986 (830 m^3/h) are as follows:

- clear well: 4.15 h
- reservoir: 0.85 h min. to 5.25 h max.
- total: 5.00 h to 9.40 h (depending upon rate of flow and level of water surface in reservoir)

Although favourable conditions for the formation of TTHM prevail, actual levels formed are low. This points to the fact that most of the precursor materials in the raw water are removed in the sedimentation basins.

E.3.2 EVALUATION OF OPTIMUM DISINFECTION PROCEDURES

Having reviewed the existing chlorination practice in detail, we found that no major modifications are required at this time to improve the process. Several suggestions to be considered are as follows:

1) The use of acidified alum should be investigated to improve disinfection during periods of high raw water pH.

2) A second chlorine scale should be installed and dedictated to the postchlorinator.

In the long-term, consideration should be given toward postammoniation of the treated water to control microorganisms in the distribution system. Ammoniation of the treated water has several advantages especially for water supply systems with large distribution systems or long transmission mains. For instance, chloramines are stabler than free chlorine and provide a long-lasting residual in the distribution system. For this reason also, the post-chlorine residual could be reduced to possibly 0.45 to 0.55 mg/L from the current levels of 0.9 to 1.0 mg/L. In addition, chloramines will reduce, if not eliminate, the potential for

TABLE E.6

PURGEABLE ORGANICS IN TREATED WATER - 3-YEAR SUMMARY

	1986		1985		1984	
	Avg.	Range	Avg.	Range	Avg.	Range
Chlorodibromomethane	5	3-7	5	5-6	5	3-6
Chloroform	24	12-47	31	16-40	26	13-46
Dichlorobromomethane	12	5-16	16	12-20	13	9-19
Total Trihalomethane	41	22-66	52	35-60	44	25-71

All units in μg/L

production of additional chlorinated by-products in the distribution system.

E.3.3 CAPABILITY OF EXISTING PLANT

As already inferred above, the existing chlorination facilities and plant operating practice are adequate for the production of disinfected water. Plant management and staff are to be commended for the excellent track record achieved to-date in producing a high quality effluent.

The levels of TTHM formed are low and do not appear to pose a health risk to the consumers.

E.3.4 REQUIREMENTS FOR OPTIMUM DISINFECTION PROCEDURES

Short-term changes identified above will require the installation of one additional chlorine scale. The use of acidified alum during certain times of the year will require further study by plant management.

Long-term modifications require the installation of ammonia storage and feed facilities. We suggest the use of aqua ammonia rather than gas which eliminates requirements for softening dilution water and problems associated with the storage and metering of a hazardous gas. Space for ammonia storage and feed equipment is available as it was provided for in the original design of the plant.

E.4 OTHER CONCERNS

E.4.1 TASTE AND ODOUR CONTROL

Powdered activated carbon is used for the control of taste and odour. For 1986 the average carbon dosage varied from 0.7 mg/L for February to 9.7 mg/L for August. The range in average monthly dosages was similar for 1985 and 1984. Higher dosages are required during August and September each year - the highest daily dosage on record being 36.7 mg/L for August 1984.

Carbon treatment effectively controls tastes and odours in the raw water at the St. Thomas treatment plant.

E.4.2 FLUORIDE

Sodium silicofluoride in solution form is added to the treated water for the control of dental caries in children.

Raw water fluoride concentrations vary from 0.11 to 0.2 mg/L for the 3-year record. Monthly average day dosages that were added ranged from 0.93 to 1.15 mg/L for 1986, 1.11 to 1.32 mg/L for 1985, and 0.79 to 1.26 mg/L for 1984. The range in monthly average day fluoride residuals for the same years were 1.23 mg/L, 1.27 mg/L and 1.13 mg/L respectively.

In reviewing the daily records of Table 4.1 it will be noted that on several occasions the residual fluoride concentration in the treated water was less than the dosage added on that day. This will be evident from December 1986 values when the imbalances in residual to dosage for 12 days of the month varied from 0.02 to 0.12 mg/L. The error is even greater considering that the raw water has a background residual of 0.1 to 0.2 mg/L.

For several days in November 1986 the opposite occurred and fluoride residual exceeded the daily dosage by a fair margin (November 4, 5 and 6).

The above inconsistencies may be due to:

1) incorrect flow reading
2) incorrect loss of weight recording/reading from the fluoride feeder
3) error in fluoride analysis.

Fluoride is analysed in the lab by SPADNS method using a Hach DR/2 Spectrophotometer.

It is suggested that plant management review the current procedures for calculating the fluoride dosage and determining the fluoride residual in the treated water.

E.4.3 ALUMINUM IN RAW AND TREATED WATER

Aluminum analyses on raw and treated water are carried out in the plant laboratory using the Hach DR/2 Spectrophotometer.

The monthly average day readings for raw water range from 0.01 to 0.04 mg/L for 1986 to 1984. The raw water pH for the same period varied from 7.7 to 8.3 units. These results appear to be low since at equilibrium in a pure system the minimum solubility of aluminum hydrolysis species is 0.004 mg/L as Al at a pH of about 5.8 and increases logarithmically with increasing pH to about 1.7 mg/L as Al at a pH of 8.5[1]. Values of 0.1 to 1.0 mg/L Al are normally found in surface waters within the above pH range.

Similarly, aluminum residuals in the treated water were quite low varying from 0.008 to 0.04 mg/L for the monthly daily average values of the 3-year record. The monthly treated water pH for this period varied from 7.20 to 7.59 units. It is known that the solubility of aluminum hydroxide species at equilibrium is about 0.13 mg/L Al at a pH of 7.4, hence the plant results are suspect.

A jar test was performed on raw water collected from the plant on October 16, 1987. Two analyses for aluminum were carried out on the raw water and four on settled water from Jar Test 1 at the Enviroclean Laboratory in London, Ontario. The average raw water aluminum concentration was 0.13 mg/L (0.11 - 0.16 mg/L) at a pH of 8.26 and the treated water concentration was 0.15 (0.12 - 0.20 mg/L) at a pH of 7.77.

([1]) Amirtharajan, A. & Mills, K.J., Rapid Mix Design for Mechanisms of Alum Coagulation. Journ. AWWA, 74:4:210 (Apr. 1982)

In view of the low aluminum residual values in raw and treated water obtained from the plant tests, it is suggested that the test procedure be reviewed and water samples be submitted to an outside laboratory for confirmation of plant test results.

E.4.4 STABILITY OF WATER

The Langelier Index for the treated water is negative, equalling -0.8 during the summer and about -1.0 during the winter. This indicates that in the presence of oxygen the water will corrode metal piping. The water is generally deemed to be non-corrosive if the index is zero or slightly positive. For this reason it would be prudent to investigate means for stabilization of the treated water that is supplied to the consumer.

E.4.5 WASH WATER CONSUMPTION

Filter backwash water consumption for 1986 as a percentage of treated water averaged 3.12% and the range for monthly average values was 2.36% to 5.58%. These rates of backwash water consumption are higher than those normally experienced with conventional treatment. The validity of the data and methods for reducing the amount of backwash water used should be investigated.

SECTION F

RECOMMENDATIONS

SECTION F - RECOMMENDATIONS

F.1 SHORT-TERM MODIFICATIONS

a) Operations and Process Control

1. Initiate a flow meter calibration programme to verify the accuracy of existing meters and, if necessary, to recalibrate flow meter instrumentation.

2. Prepare and maintain an up-to-date process piping flow diagram at the plant.

3. Operate both pretreatment modules during peak summer demand peridos.

4. In the calculation of the applied alum dosage, a concentration factor of 649 kg/m^3 for the alum solution is currently being used. For commercial strength alum solution (48.18% alum by weight, S.G. of 1.33) the correct factor is 640.8 kg/m^3. This value (640.8 kg alum per m^3 of solution) should be adopted for future calculation of the applied alum dosage.

5. Confirm the accuracy of the sodium silicofluoride loss-of-weight recorder and verify analytical test results for fluoride obtained with the plant lab spectrophotometer.

6. Results for dissolved aluminum in the raw and treated water are very low. The validity of the results should be confirmed by verification of test procedures and confirmation of results with an outside lab.

7. Consideration should be given to reducing the aggressiveness of the treated water.

8. The wash water consumption as a percentage of treated water flow is higher than normal and the validity of the records and methods

for reducing the amount of backwash water used should be investigated.

9. The filter media should be inspected at regular intervals; perhaps as often as every six months.

b) Particulate Removal

1. Continuous Monitoring of Optimum Coagulant Dosage

Investigate the benefits of using a Streaming Current Detector with strip chart recorder to monitor the optimum coagulant dosage as determined in the laboratory by jar tests and/or streaming current titrations.

Estimated Cost: $16,000

2. Flocculant Aid

Investigate the benefits for using a polyelectrolyte as a flocculant aid in the treatment process.

Benefits to be derived from using a flocculant aid include:

1) the need for a lower alum dosage hence the production of less alum sludge requiring treatment and disposal,

2) production of a faster settling floc with better filtering characteristics.

If the investigation produces positive results, and management decides to implement a flocculant aid feed system, then polymer storage and feed equipment will have to be provided. A preliminary estimate of the cost for the installation of such a feed package is:

$60,000

3. Filter Preconditioning

Several studies have shown that filter preconditioning with a polymer or coagulant will result in lower levels of turbidity breakthrough and for a shorter duration, in a filter at start-up following a wash. This procedure, which can be achieved by adding a polymer to the rinse cycle of the filter backwash, should be investigated for possible implementation.

4. Filter Operation

In order to reduce filter breakthrough after a wash, management should investigate letting a filter rest for about 15 minutes after a wash before returning the filter to service.

An additional way of reducing filter breakthrough after start-up is to filter to drain. This procedure should be investigated, at reduced filter rates, using the manually controlled filter drain pipe. If the procedure proves to be successful, further studies will have to be carried out to determine requirements for the installation of filter to drain piping capable of handling the design flow rate of the filter.

c) Disinfection

1. Monitoring Postchlorination Dosage

A separate weigh scale for postchlorination service should be installed.

2. Adjustment of Raw Water pH

Improve the efficiency of disinfection by lowering the raw water pH to about 7.2 to 7.4. This may be achieved by using acidified alum as a coagulant. Treatment at a lower raw water pH would have additional benefits such as: 1) improvement in the efficiency of alum coagulation, and 2) reduction in the aluminum carry-over in the treated water.

Sulphuric acid could be considered as an alternate chemical for pH reduction.

The estimated cost for a sulphuric acid application package is:

$50,000.

F.2 LONG-TERM MODIFICATIONS

a) Particulate Removal

Modify Rotodip alum feeders to provide for automatic dosage control relative to the Streaming Current Detector output signal.

b) Disinfection

At the present there are no problems with bacteria in the distribution system. Effective control is achieved by maintaining a high chlorine residual in the water leaving the plant and, in the case of the Port Burwell supply, by re-chlorinating the water at the elevated tank. An alternate method, practiced by large municipalities in Ontario to control microorganisms in the distribution system, is to postammoniate the treated water at the plant. This technique should be considered for application at the St. Thomas plant if problems with bacterial growth and the development of taste and odour should be experienced in the distribution system.

The estimated cost for the installation of a postammoniation treatment package, consisting of aqueous ammonia storage and feed facilities is:

$40,000

APPENDIX A

DAILY LOG

Ministry of the Environment
Ontario

Elgin Area Water System

Daily Log

DATE: SATURDAY OCT 11 1986 19

OPERATOR 1	OPERATOR 2	OPERATOR 3
Ryan	R Hilleman	

LOW LIFT	1.	2.	3.	4.
STOP	35.5	25.1	41.9	88.2
START	35.5	25.1	41.9	88.2
TOTAL	—	—	—	—
			TOTAL	—

HIGH LIFT	1.	2.	3.	4.
STOP	77.1	44.2	89.0	99.3
START	77.1	44.2	65.0	99.3
TOTAL	—	—	24.0	—
			TOTAL	24.0

WASH	1.	2.
STOP	87.9	87.4
START	87.9	86.9
TOTAL	—	.5
	TOTAL	.5

PEAK HOUR RATES	OPR 1	OPR 2	OPR 3	DAY
PLANT TREATED				24
PT. BURWELL W.M.	1.8			
BOOSTER STN.				32
ST. THOMAS				29.5
FORD W.M.	6.3			

19.8

METER	RAW (X5)	FILTERED (X5)	WASH (X5)	SERVICE (X.5)	TREATED (X5)	PT. BURWELL	BOOSTER (X5)	ST. THOMAS E.	ST. THOMAS W.	FORD W.M.	
STOP	11048332	307746	590941	450830	156679	1859838	348667	4802982	5797888	1638632	
START	11043759	303199	590753	449340	153058	1859114	344868	4799370	5785086	1636450	
TOTAL	4573	4547	188	1490	3621		3799	3612	12802		
m3	24365	22735	940	745	18105	724	18995	16414		3182	

CHEMICAL	CHLORINE		ALUM	CARBON	FLUORIDE
USED kg	Pre 29.5	Post 6.8	597.1	147.0	34.5
DOSAGE mg/l	1.29	0.34	24.5	6.0	1.05
TOTAL	36.3				

FILTERS

No.	Time Washed	Head Loss	Run Hrs.	Remarks
2	13:00	1.7	105	w/ 5.2 % of treated

ALUM FEEDER STEP UP

TIME	TURB.	SETTING	TIME	TURB.	SETTING
00:30	65	330			
03:00	55	300			
08:30	78 ↑	380 - 430			
15:30	210	560 - 600			
17:00	320	680			
20:30	285	590 - 550			
22:00	230 - 200	520 460			
22:30	170	420			

GENERAL CHEMICAL

TIME	CHEMICAL	FROM	TO	FLOW	TIME	CHEMICAL	FROM	TO	FLOW
20:30	Pre Cl2	77	74	4					

1058 8/82

Ministry of the Environment
Ontario

Elgin Area Water System

DAY	DATE
Sunday	23 - 11 - 1986

Daily Lab Report

CHLORINE RESIDUALS

Time	Floc	Settled	Filtered	Effluent	Eff. Free	Eff. % Free	Opr.
00:30			.72	.90			—
04:30			.72	.90			—
08:30			.71	.93	.80	86	RH
12:30			.74	.93			RH
16:30			.85	.94			RH
20:30			.85	1.00			—
AVG.			.77	.94			—

TURBIDITY F.T.U.

ODOUR

Time	Raw	Settled	Filtered	Effluent	Odour Raw	Odour Settled	Opr.
00:30	42.	6.9	.09	.10	NIL	—	—
04:30	44.	6.6	.09	.11			—
08:30	44.	7.2	.12	.10	NIL	—	RH
12:30	45	7.0	.10	.10			RH
16:30	43	6.2	.11	.12			RH
20:30	72	7.2	.08	.09			—
AVG.	48.	6.9	.10	.10			—

PHYSICAL & CHEMICAL

TEMPERATURE 15:00

Raw	10 °c
Treated	10 °c

ph

Raw	8.00
Treated	7.43

ALKALINITY

Raw	mg/l
Treated	mg/l

TOTAL HARDNESS

Raw	mg/l
Treated	mg/l

CALCIUM

Raw	mg/l
Treated	mg/l

MAGNESIUM

Raw	mg/l
Treated	mg/l

CHEMICAL RESIDUALS

CHLORINE

Filter Effluent No.	mg/l
Booster	mg/l

FLUORIDE

Raw	mg/l
Treated	1.09 mg/l

ALUMINUM

Raw	mg/l
Treated	mg/l
Booster	mg/l
Port Burwell	mg/l

CHEMICAL DOSAGE

Chlorine Pre	1.38 mg/l
Chlorine Post	.29 mg/l
Fluoride	1.07 mg/l
Aluminum	17.2 mg/l
Carbon	3.3 mg/l

APPENDIX B

JAR TEST RESULTS

APPENDIX B - JAR TEST RESULTS

Jar tests were carried out on raw water taken from the St. Thomas W.T.P. on October 16, 1987, when the raw water turbidity was relatively high at about 53 NTU.

Two tests were run in order to establish the optimum alum coagulant dosage for treatment. Test procedures and results obtained are presented at the end of this appendix. It will be noted that test parameters used for determining the optimum dosage include: time to when floc becomes visible, floc appearance, flox size and quantity, settling velocity, and turbidity of filtrate from a laboratory filter paper. Results for settled water turbidity are plotted in terms of settling velocity distribution curves for each test. Settling velocities measured ranged from 0.469 cm/min. (140 Igpd/sf) to 6.00 cm/min. (1800 Igpd/sf).

The aluminum content in the raw water measured 0.84 mg/L total and 0.16 mg/L dissolved for Sample 1 and 0.11 mg/L total and 0.11 mg/L dissolved for Sample 2. Dissolved aluminum residuals in filtered water from Test 1 were 0.12, 0.13, 0.20 and 0.17 mg/L in jars 2, 3, 4 and 5 respectively. Anlayses were done by Enviroclean, a Division of MacLaren Plansearch Inc.

For Test 1, the raw water turbidity was 53.2 NTU, the temperature 22°C, and the pH 8.25. Apparent colour was measured at 30 Hazen units. Good treatment was obtained with an alum dosage of 15 mg/L; while at 20 mg/L the results were even better. To narrow down the optimum dosage point Jar Test 2 carried out. For this test the raw water turbidity was 52.7 NTU and the pH was 8.27 units. Values for colour and temperature were identical to those in Test 1. Based on the results of Test 2, and the objective for obtaining the best treatment with the least amount of chemical consumption, 16 mg/L alum was the optimum alum dosage. At this dosage large, spherical and tight floc were formed. The maximum settling velocity measured was 4.29 cm/min. at which a satisfactory water turbidity of 1.50 NTU was achieved. This settling velocity is equivalent to 2.578 m/h or 1264 Igpd/sf. For full-scale design this

rate should translate to a maximum sedimentation tank overflow rte of 1.29 m/h or 630 Igpd/sf. The filtrate turbidity of 0.08 NTU is indicative of good coagulation leading to a high quality effluent in full-scale treatment.

Conclusions that may be drawn from the jar test trials are as follows:

1. The optimum alum dosage is about 16 mg/L for a raw water turbidity in the order of 50 NTU, a pH of 8.27 units and water temperature of 22°C.

2. The maximum settling velocity in the jars resulting in acceptable water quality was found to be 4.29 cm/min. or 1.29 m/h (630 Igpd/sf) for full-scale design.

3. Although laboratory filter test results do not allow prediction of plant filter design parameters, the result show that good filter performance can be expected at the optimum alum dosage with a well designed filter.

JAR TEST PROCEDURE

1. Obtain sufficient raw water sample to test for raw water quality (turbidity, pH, temperature, colour, alkalinity) and to fill 6 1.5 L glass jars with exactly 1 L of sample.

2. Place all 6 jars in the gang stirrer and begin mix at 100 rpm. Quickly add the desired amount of primary coagulant to each jar. Add the coagulant to the vortex created by the fast stirring paddles. After coagulant has been added to the last jar, continue rapid mix for 60 seconds, then reduce the paddle speed to 30 rpm.

3. If secondary coagulant is to be used as well, quickly add this in the desired amount to each jar during rapid mix. If the secondary coagulant is a polymer, then this should be added after the addition of primary coagulant. If activated silica is used, then the order of addition should be noted.

4. Continue slow mix at 30 rpm for 30 minutes. After 30 minutes, the paddles should be stopped and removed from the jars.

5. Following the start of the slow mix, observe the time of the first appearance of visible floc in each of the six jars, and also the appearance, size and quantity of floc at the end of the agitation or flocculation period.

6. After 30 minutes of slow mix allow the samples to settle. From a fixed depth of 5 cm, the mid-point of the water depth in the jar, collect samples at 1,2, 4 and 8 minutes after the start of settling and analyse samples for turbidity. Samples drawn at these times represent settling velocities of 5, 2.5, 1.25 and 0.625 cm/min. respectively. Plot the results in terms of settling velocity distribution curves.

7. Following the settling period, pipette 200 mL of supernatant from each jar. Use 50 mL to wet a glass fibre filter disc and discard.

Filter the remaining sample and measure the turbidity of the finished water. Use a separate filter apparatus and filter disk for each sample from each jar. Use Gelman Sciences Type A/E 47 mm glass fibre filters or Whatman No. 40 filter discs.

ST. THOMAS WATER TREATMENT PLANT

JAR TEST RESULTS

JAR TEST NUMBER: 1

RAW WATER CHARACTERISTICS
TURBIDITY : 53.2 NTU
COLOUR : 30 ACU
TEMPERATURE : 22° C
pH : 8.25

JAR #	COAGULANT and DOSE (mg/L)	FLOC CHARACTERISTICS				SETTLED WATER SAMPLES								FILTERED WATER SAMPLES	
		Time to 1st floc	Appearance	Size	Quantity	Time (min:sec)	Turbidity (NTU)	Time (min:sec)	Turbidity (NTU)	Time (min:sec)	Turbidity (NTU)	Time (min:sec)	Turbidity (NTU)	Turbidity (NTU)	pH
1	Alum 5	immed.	small floc; sample still turbid between floc particles after 30 min.	2 mm	4	1:40	16.8	2:40	17.5	4:40	17.0	10:40	14.6	0.86	7.94
2	Alum 10	immed.	small/medium floc; sample clears of turbidity between particles after 15 min.	3 mm	4	1:30	4.2	2:30	3.6	4:30	3.8	10:30	3.3	0.14	7.87
3	Alum 15	immed.	medium size floc; sample clears after 10 min.; some smaller particles remaining after 30 min.	4 mm	5	1:20	2.2	2:20	1.8	4:20	2.1	10:20	1.7	0.11	7.80
4	Alum 20	immed.	large, spherical, tight floc; no apparent shear damage; sample cleared of turb. b/w particles in 4 min	4 mm	5	1:10	1.3	2:10	0.98	4:10	1.03	10:10	1.06	0.09	7.74
5	Alum 25	immed.	floc characteristics same as jar no. 4; turbidity cleared between particles in 2.5 min.	4 mm	5	1:00	1.0	2:00	0.55	4:00	0.57	10:00	0.73	0.11	7.69
6	Alum 30	immed.	floc characteristics same as jar no. 4; turbidity cleared between particles in 2 min.	4 mm	5	0:50	4.4	1:50	0.58	3:50	0.45	9:50	0.51	0.11	7.50

ST. THOMAS WATER TREATMENT PLANT

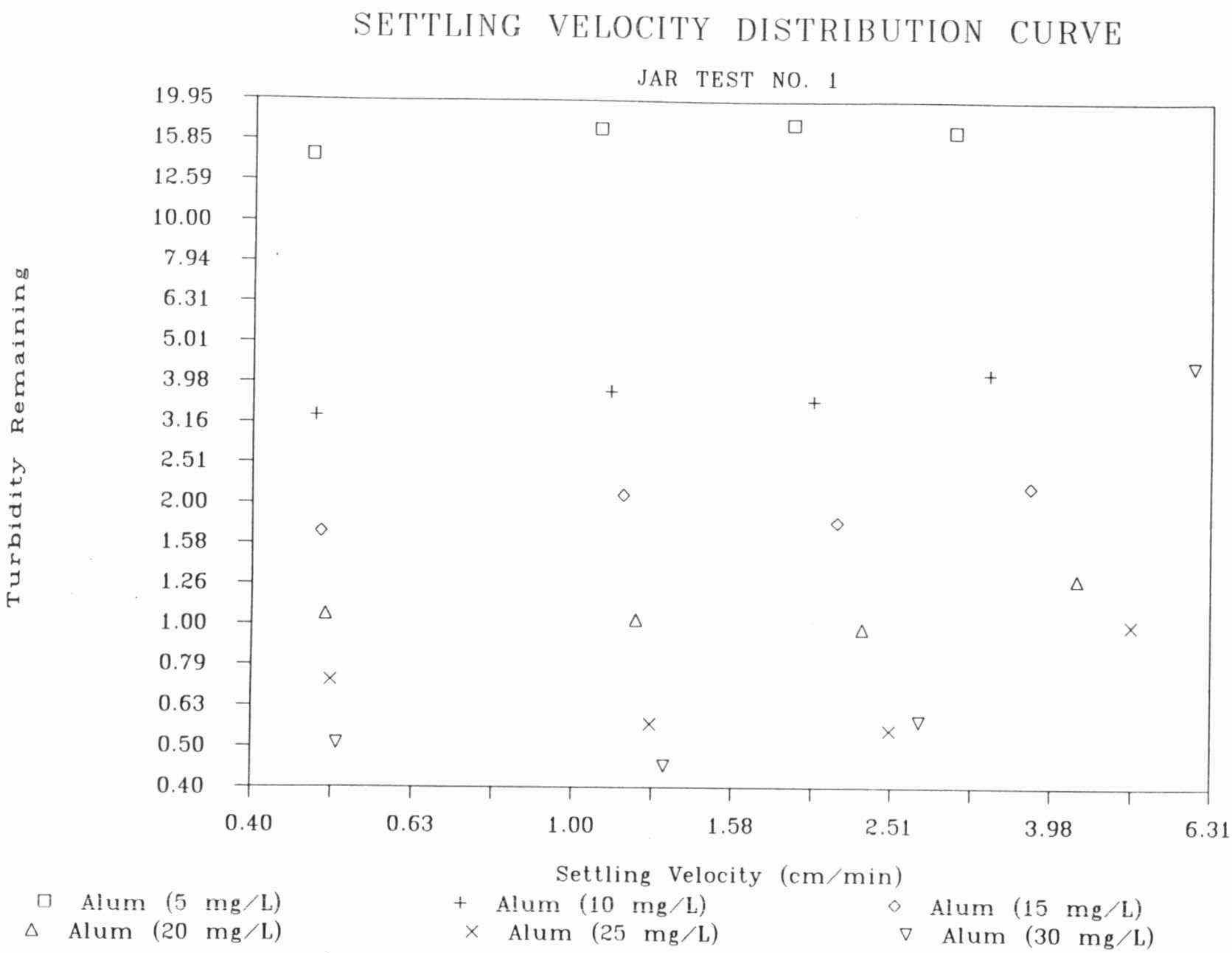
JAR TEST RESULTS

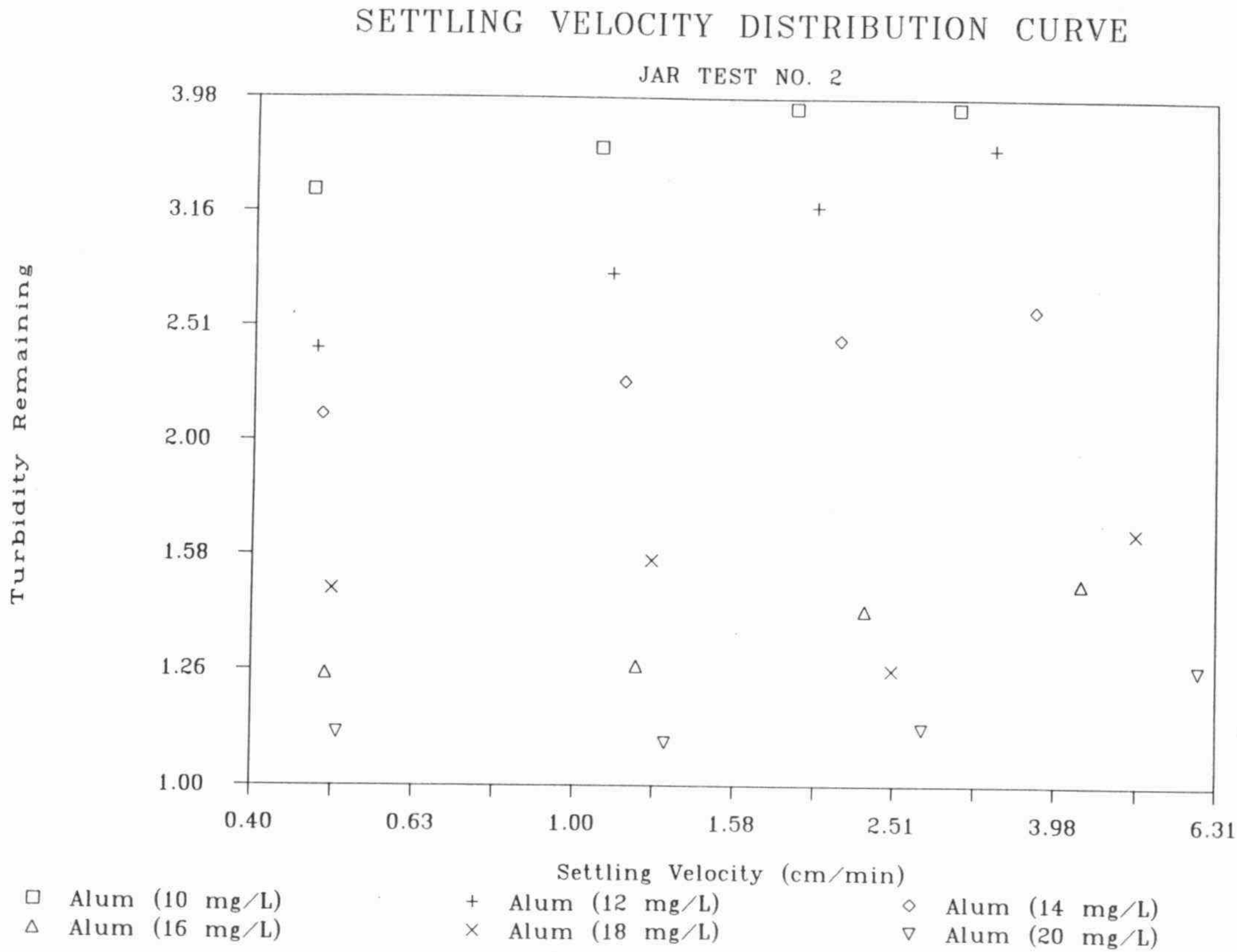
JAR TEST NUMBER: 2

RAW WATER CHARACTERISTICS

TURBIDITY : 52.7 NTU
COLOUR : 30 ACU
TEMPERATURE : 22° C
pH : 8.27

JAR #	COAGULANT and DOSE (mg/L)	FLOC CHARACTERISTICS				SETTLED WATER SAMPLES								FILTERED WATER SAMPLES	
		Time to 1st floc	Appearance	Size	Quantity	Time (min:sec)	Turbidity (NTU)	Time (min:sec)	Turbidity (NTU)	Time (min:sec)	Turbidity (NTU)	Time (min:sec)	Turbidity (NTU)	Turbidity (NTU)	pH
1	Alum 10	immed.	small/medium floc; sample clears of turbidity between particles after 15 min.	3 mm	4	1:40	3.9	2:40	3.9	4:40	3.6	10:40	3.3	0.15	7.91
2	Alum 12	immed.	medium floc; sample clears of turbidity between particles after 14 min.	4 mm	5	1:30	3.6	2:30	3.2	4:30	2.8	10:30	2.4	0.11	7.88
3	Alum 14	immed.	medium/large size floc; sample clears after 10 min.; some smaller particles remaining after 30 min.	4 mm	5	1:20	2.60	2:20	2.45	4:20	2.25	10:20	2.1	0.11	7.86
4	Alum 16	immed.	large, spherical, tight floc; no apparent shear damage; sample cleared of turb. b/w particles in 6 min.	4 mm	5	1:10	1.50	2:10	1.42	4:10	1.27	10:10	1.25	0.08	7.85
5	Alum 18	immed.	floc characteristics same as jar no. 4; turbidity cleared between particles in 5 min.	4 mm	5	1:00	1.66	2:00	1.26	4:00	1.57	10:00	1.48	0.13	7.83
6	Alum 20	immed.	floc characteristics same as jar no. 4; turbidity cleared between particles in 4 min.	4 mm	5	0:50	1.26	1:50	1.12	3:50	1.09	9:50	1.11	0.12	7.74


SETTLING VELOCITY DISTRIBUTION CURVE
JAR TEST NO. 1
19.95
15.85
12.59
10.00
7.94
6.31
5.01
3.98
3.16
2.51
2.00
1.58
1.26
1.00
0.79
0.63
0.50
0.40
Turbidity Remaining
0.40
0.63
1.00
1.58
2.51
3.98
6.31
Settling Velocity (cm/min)
Alum (5 mg/L)
Alum (10 mg/L)
Alum (15 mg/L)
Alum (20 mg/L)
Alum (25 mg/L)
Alum (30 mg/L)



SETTLING VELOCITY DISTRIBUTION CURVE
JAR TEST NO. 2
Turbidity Remaining
3.98
3.16
2.51
2.00
1.58
1.26
1.00
0.40
0.63
1.00
1.58
2.51
3.98
6.31
Settling Velocity (cm/min)
Alum (10 mg/L)
Alum (12 mg/L)
Alum (14 mg/L)
Alum (16 mg/L)
Alum (18 mg/L)
Alum (20 mg/L)

~~JVH~~
H10 Files

ENVIROCLEAN LONDON · TORONTO
A DIVISION OF MacLAREN PLANSEARCH INC.
320 ADELAIDE STREET SOUTH, LONDON, ONTARIO N5Z 3L2 (519) 686-7558

Att: R. Machacek (Toronto)

PROJECT NO.: 43119-A7-050000 for 43761-A1-000000 CLIENT: Misc. Toronto for Pt. Stanley Jar Tests SOURCE: Water samples

ANALYTICAL RESULTS - Milligrams per litre (except for pH values and where stated)

SAMPLE NO.	DATE AND TIME TAKEN	DATE ANALYSIS COMMENCED	DESCRIPTION	Total Aluminium Al	Dissolved Aluminium Al	pH Raw Water Test 1	Jar Test Alum Dosage					
87/12079	16 Oct 87	23 Oct 87	Sample #1 - RW Test 1	0.84	0.16	8.25						
12080	"	"	" 2 - RW Test 2	0.11	0.11	8.27						
12081	"	"	" 3 - FW Test 1	-	0.12	7.87	10					
12082	"	"	" 4 - FW Test 1	-	0.13	7.80	15					
12083	"	"	" 5 - FW Test 1	-	0.20	7.74	20					
12084	"	"	" 6 - FW Test 1	-	0.17	7.69	25					

Legend:

RW = Raw Water
FW - Filtered Water

2/81
6-032-81-06(C-1-1)

20 Nov 87

R. Whitehead, Ph.D., C. Chem.

APPENDIX C

TABLES OF OPERATING RECORD

TABLE 1

WATER PLANT OPTIMIZATION STUDY

"PLANT FLOWS"

TABLE 1.0: FLOWS (ML/d)

MOE WPOS PROTOCOL

		1986			1985			1984			1983		
		MAX.	MIN.	AVG.	MAX.	MIN.	AVG.	MAX.	MIN.	AVG.	MAX.	MIN.	AVG.
JAN	R	29.03	17.10	23.67	26.11	14.27	21.34	25.53	15.36	22.14			
	T	21.45	12.58	17.31	32.15	14.28	21.72	28.27	18.70	25.29			
FEB	R	27.46	15.85	23.29	27.98	16.20	23.25	26.93	18.36	22.69			
	T	20.67	10.80	17.27	28.25	16.77	22.96	29.38	17.21	25.66			
MAR	R	26.40	17.44	23.84	26.34	16.70	23.15	24.67	17.02	22.69			
	T	19.75	13.45	18.19	23.18	12.59	18.45	27.63	20.38	25.80			
APR	R	27.08	20.15	24.61	31.65	14.47	23.92	26.39	14.95	22.54			
	T	23.29	14.12	19.48	23.90	11.46	18.31	31.35	22.91	27.75			
MAY	R	31.86	16.29	25.99	31.50	16.96	24.30	24.20	12.08	22.45			
	T	26.51	10.94	20.56	25.03	13.33	19.39	30.00	12.40	20.85			
JUN	R	38.09	16.02	26.48	33.10	17.55	25.94	31.95	19.89	25.24			
	T	30.74	13.49	20.77	25.87	12.79	20.90	33.51	16.38	21.82			
JUL	R	32.44	17.40	25.43	31.75	16.05	24.57	29.09	17.10	22.82			
	T	27.32	11.89	20.65	25.38	12.70	19.49	34.44	8.80	20.09			
AUG	R	30.25	16.50	24.82	35.22	22.33	28.68	30.40	14.70	24.85			
	T	27.11	11.87	21.87	27.92	18.93	23.01	35.64	15.65	23.94			
SEP	R	31.30	19.82	26.51	31.21	21.20	26.64	32.08	21.04	24.75			
	T	28.10	16.72	22.88	24.43	17.59	21.07	35.19	18.82	24.29			
OCT	R	32.51	16.35	25.83	29.54	21.20	26.18	30.93	15.48	23.72			
	T	27.92	13.41	20.43	23.83	15.38	19.79	33.85	14.68	23.12			
NOV	R	31.32	16.62	24.49	31.10	17.05	25.59	28.19	16.75	22.99			
	T	25.58	12.40	18.97	23.21	10.71	18.28	28.61	17.30	23.06			
DEC	R	28.46	13.63	23.56	29.23	16.55	23.27	24.14	12.04	21.04			
	T	22.78	9.02	18.34	21.48	10.94	16.44	23.18	12.27	20.83			

TABLE 1.1: DAILY FLOWS (ML/d) 1986

MOE WPOS PROTOCOL

RAW WATER

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
MON									19.82			26.50
TUE				27.08			26.46		30.02			27.22
WED	18.92			25.19			28.38		30.05	26.45		26.56
THU	26.29			25.11	26.49		32.44		26.52	29.40		28.02
FRI	24.96			24.56	26.05		26.00	25.67	29.18	29.77		25.05
SAT	19.39	21.45	23.43	24.50	24.94		26.00	21.72	24.91	16.35	23.50	24.04
SUN	21.46	17.79	18.71	20.15	25.15	25.14	19.68	21.52	20.82	25.18	17.96	23.68
MON	26.48	25.93	24.49	26.19	22.80	31.75	30.93	16.50	25.89	28.92	23.22	21.60
TUE	29.03	24.12	26.37	25.55	25.96	16.02	27.50	29.71	30.22	29.70	28.10	26.90
WED	27.27	24.32	25.52	23.99	26.90	38.09	24.35	21.80	26.50	24.98	25.70	25.17
THU	26.52	22.74	26.40	24.85	27.62	28.19	23.44	28.30	26.30	32.89	25.41	27.02
FRI	24.36	22.96	24.17	26.88	26.48	26.02	24.82	23.78	31.30	26.13	23.56	25.24
SAT	23.84	21.05	21.80	24.01	24.05	26.79	25.63	22.24	22.27	24.37	24.44	23.54
SUN	19.05	19.95	17.44	24.29	24.09	21.03	17.40	22.81	23.16	19.57	16.92	23.34
MON	24.94	23.42	23.41	24.43	24.52	31.60	24.77	28.58	24.01	20.10	28.63	24.64
TUE	24.09	24.73	24.98	24.06	31.70	31.80	30.10	22.52	30.61	25.33	24.68	25.14
WED	23.69	21.80	24.79	24.35	28.96	25.46	22.40	24.96	30.50	32.51	28.12	26.32
THU	28.23	24.03	24.31	23.57	22.86	30.35	22.73	25.37	28.61	30.05	24.48	28.46
FRI	24.70	24.85	24.51	26.97	29.87	23.47	21.30	25.50	22.46	25.71	24.09	23.60
SAT	20.64	24.59	24.69	24.82	23.65	25.18	23.75	24.40	22.41	25.36	24.14	23.50
SUN	19.03	15.85	18.37	21.99	24.67	24.73	24.90	21.41	29.10	19.38	19.80	20.38

TABLE 1.1 (cont'd.)

RAW WATER - 1986

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
MON	24.98	27.46	25.42	24.61	16.29	21.17	25.95	28.65	23.82	23.43	27.29	25.88
TUE	24.02	26.39	24.54	24.28	26.05	28.54	30.33	30.21	27.91	26.84	24.97	23.48
WED	24.28	22.35	25.30	24.49	29.75	31.20	26.96	30.16	30.54	29.03	24.58	23.60
THU	24.35	24.70	23.94	25.04	23.71	23.02	26.63	25.48	27.51	24.77	30.98	15.14
FRI	24.04	25.28	25.70	26.33	24.79	30.80	28.70	30.25	29.89	31.25	24.19	13.63
SAT	17.10	23.42	25.08	23.30	24.47	25.85	24.45	23.76	20.85	23.24	23.19	20.72
SUN	21.66	22.31	23.26	20.30	24.85	22.73	22.19	22.14	25.58	18.60	23.42	16.45
MON	23.34	23.27	22.16	26.87	26.44	21.96	22.51	26.08	30.11	24.23	24.32	18.65
TUE	24.38	24.07	25.99	26.69	28.86	32.85	26.80	25.92	25.01	25.50	31.32	22.34
WED	25.53	24.37	25.51	23.80	25.14	24.05	22.11	25.35		27.59	23.46	24.58
THU	24.08	25.65	25.99		31.86	28.69	28.64	29.93		24.47	25.33	
FRI	23.16	23.39	24.19		31.09	28.81		25.08		29.75	28.48	
SAT			24.18		25.63	25.29		22.47			23.78	
SUN			22.63			24.13		17.10			16.62	
MON			21.68			19.84						
TUE												
MAX	29.03	27.46	26.40	27.08	31.86	38.09	32.44	30.25	31.30	32.51	31.32	28.46
MIN	17.10	15.85	17.44	20.15	16.29	16.02	17.40	16.50	19.82	16.35	16.62	13.63
AVG	23.67	23.29	23.84	24.61	25.99	26.48	25.43	24.82	26.51	25.83	24.49	23.56

TABLE 1.1: DAILY FLOWS (ML/d) 1985

RAW WATER

MOE WPOS PROTOCOL

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
MON				24.33			23.26					
TUE	14.50			22.92			21.50			27.00		
WED	21.55			24.96	26.36		26.00			24.82		
THU	22.25			24.84	26.05		31.75	26.97		28.88		
FRI	22.81	23.06	24.30	23.31	22.41		30.59	32.57		24.88	28.92	
SAT	17.51	19.66	23.64	14.47	23.20	26.13	20.78	32.49		23.50	24.02	
SUN	20.90	17.40	22.97	17.37	23.60	22.88	16.05	24.18	23.71	21.20	19.07	20.08
MON	20.45	23.10	21.48	25.49	22.49	23.34	23.54	26.42	23.35	24.47	26.66	25.19
TUE	26.11	22.05	23.66	26.97	23.14	32.26	29.28	32.32	27.67	28.92	27.99	25.16
WED	23.92	23.39	24.05	25.95	25.02	25.79	21.82	30.21	28.38	23.94	29.70	25.44
THU	22.65	23.49	24.03	24.49	24.38	31.77	20.01	27.59	30.53	30.53	24.55	24.67
FRI	21.95	21.48	19.54	24.40	28.41	26.08	21.45	32.74	31.21	27.40	25.05	26.13
SAT	16.57	24.79	23.52	23.11	23.66	30.65	23.32	35.22	23.42	28.06	26.10	26.38
SUN	22.88	21.76	22.37	18.21	23.26	25.28	20.12	34.11	28.39	23.02	17.05	20.21
MON	23.04	23.70	23.98	24.92	22.58	28.89	19.59	29.82	25.70	22.23	24.45	24.79
TUE	21.61	22.28	22.93	24.73	29.97	29.90	23.71	33.89	30.67	26.62	31.10	26.25
WED	18.93	22.20	24.07	22.80	24.62	24.85	21.01	28.44	27.45	29.54	25.41	25.57
THU	23.27	24.23	24.74	28.49	22.50	26.82	18.42	31.54	30.15	28.31	26.64	29.23
FRI	22.81	27.35	22.41	25.19	24.07	25.13	27.26	24.64	24.44	25.72	26.34	25.17
SAT	21.51	23.00	24.23	23.71	22.92	26.56	23.02	22.90	23.84	26.10	25.17	20.29
SUN	18.00	16.20	18.74	17.90	16.96	22.10	24.15	22.33	23.83	25.35	22.18	22.43

TABLE 1.1 (cont'd.)

RAW WATER - 1985

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
MON	20.45	23.93	25.46	25.30	19.24	23.07	25.44	25.09	25.15	25.06	26.39	25.20
TUE	22.75	27.98	24.76	27.82	23.34	24.70	29.85	33.02	27.81	24.45	25.38	24.73
WED	22.25	24.55	24.19	23.95	23.82	28.97	24.15	24.04	29.03	28.74	25.36	26.14
THU	23.50	23.58	23.43	29.35	25.33	23.11	28.40	31.94	27.07	27.88	24.43	26.23
FRI	24.31	24.40	26.34	25.15	28.57	23.54	28.64	31.00	28.65	28.85	29.10	25.33
SAT	18.82	23.93	23.49	25.34	24.40	23.71	23.54	24.19	23.54	25.74	24.77	25.00
SUN	14.27	20.65	16.70	16.87	24.15	23.96	29.06	24.06	25.83	21.89	25.06	16.75
MON	23.41	26.41	23.68	23.76	21.61	24.33	31.32	26.24	27.72	25.27	21.62	27.38
TUE	22.96	25.20	24.62	31.65	23.82	27.57	30.95	33.50	31.09	28.82	26.66	18.26
WED	22.36	27.24	23.09		31.50	23.41	23.75	25.03	27.64	29.39	25.71	19.72
THU	23.33	24.10	25.03		25.22	33.10		29.88	24.60	25.06	26.94	16.55
FRI			25.07		26.59	29.47		30.17	26.00		29.01	24.04
SAT			23.70			23.29		22.57	24.37		26.75	16.84
SUN			17.34			17.55			21.20			21.07
MON									26.74			22.01
TUE												19.33
MAX	26.11	27.98	26.34	31.65	31.50	33.10	31.75	35.22	31.21	29.54	31.10	29.23
MIN	14.27	16.20	16.70	14.47	16.96	17.55	16.05	22.33	21.20	21.20	17.05	16.55
AVG	21.34	23.25	23.15	23.92	24.30	25.94	24.57	28.68	26.64	26.18	25.59	23.27

TABLE 1.1: DAILY FLOWS (ML/d) 198_

RAW WATER - 1984

MOE WPOS PROTOCOL

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
MON										20.90		
TUE					23.09					29.20		
WED		22.08			21.77			30.14		24.65		
THU		24.35	21.89		23.84			29.41		29.56	24.65	
FRI		22.00	23.18		22.35	23.67		23.40		25.03	23.40	
SAT		21.99	22.49		23.80	22.44		23.30	22.11	23.12	23.50	23.83
SUN	15.36	21.45	19.86	20.88	17.15	22.19	20.70	14.70	21.04	18.69	22.70	21.37
MON	17.41	23.01	22.56	18.90	23.65	23.00	19.97	21.65	21.84	16.87	20.80	20.65
TUE	23.53	21.91	22.98	23.61	23.25	24.64	25.40	23.45	25.56	21.85	22.65	22.65
WED	21.90	23.48	20.82	24.20	23.60	30.45	28.17	28.70	26.97	23.99	24.65	23.55
THU	23.46	21.88	23.88	22.58	22.85	24.82	27.90	25.12	22.37	23.08	25.81	23.12
FRI	23.11	22.50	23.67	22.98	23.97	23.56	22.20	29.52	22.90	30.93	26.33	22.43
SAT	22.45	22.30	22.87	23.05	22.87	23.43	22.60	22.40	22.86	21.98	16.75	23.56
SUN	15.36	22.89	17.02	22.40	23.59	24.06	17.10	18.58	22.30	15.48	20.61	18.27
MON	21.62	22.95	22.71	21.90	22.04	28.90	23.35	22.25	23.96	25.66	22.85	22.67
TUE	25.53	22.05	23.65	22.95	23.50	25.35	24.90	28.22	23.94	23.59	22.21	21.82
WED	24.74	26.93	22.63	25.17	21.90	31.95	22.62	28.43	30.38	24.24	28.19	24.11
THU	23.07	24.83	23.50	21.57	24.20	24.15	23.70	24.39	23.01	28.03	24.05	23.20
FRI	23.05	22.97	23.22	23.43	22.03	23.91	17.82	26.84	24.50	23.89	22.10	22.92
SAT	21.95	21.38	22.38	23.50	24.18	23.55	20.60	25.51	24.76	23.24	23.37	24.14
SUN	17.35	22.07	19.66	22.12	12.08	19.89	19.25	19.87	22.90	20.41	18.93	18.54

TABLE 1.1 (cont'd.)

RAW WATER - 1984

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
MON	23.00	22.82	24.32	26.39	19.30	25.71	18.02	23.91	23.11	23.66	24.01	22.05
TUE	24.96	21.71	23.32	24.62	23.51	31.68	21.22	30.15	29.82	22.94	21.85	22.79
WED	24.15	23.08	22.60	22.80	24.11	27.37	22.57	23.54	24.15	23.82	23.32	23.25
THU	23.32	22.83	24.46	24.72	22.80	23.79	19.26	28.49	30.10	27.23	27.31	23.86
FRI	25.20	22.02	23.12	23.15	24.09	30.65	21.45	24.96	22.84	22.90	25.47	22.51
SAT	21.84	22.87	23.22	18.66	22.25	23.58	22.17	21.91	26.66	22.90	18.46	23.77
SUN	22.64	18.36	23.85	14.95	23.63	20.52	21.85	21.33	22.74	20.05	21.62	20.96
MON	23.98	23.33	22.25	18.68	23.11	23.23	25.24	24.53	23.70	24.35	22.36	21.65
TUE	22.62	24.18	23.96	21.97	22.21	29.66	29.09	30.40	32.08	22.90	23.03	12.04
WED	22.50	23.75	22.42	23.94	22.45	24.15	22.91	22.82	26.27	30.05	23.15	17.57
THU	24.29		24.67	23.46	23.85	27.78	26.34	29.63	30.80		23.23	14.76
FRI	21.79		21.98	25.11		25.63	23.65	22.74	22.50		22.25	18.90
SAT	22.27		24.42	23.16		23.63	22.65		23.00			13.10
SUN	19.61			21.84			22.21		23.25			19.20
MON	22.48			23.63			27.80					19.15
TUE	21.94						24.89					
MAX	25.53	26.93	24.67	26.39	24.20	31.95	29.09	30.40	32.08	30.93	28.19	24.14
MIN	15.36	18.36	17.02	14.95	12.08	19.89	17.10	14.70	21.04	15.48	16.75	12.04
AVG	22.14	22.69	22.69	22.54	22.45	25.24	22.82	24.85	24.75	23.72	22.99	21.04

TABLE 1.1: DAILY FLOWS (ML/d) 1986

TREATED WATER

MOE WPOS PROTOCOL

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
MON									16.72			20.82
TUE				23.29			20.89		25.93			21.46
WED	12.16			19.74			21.38		28.10	22.35		21.18
THU	18.45			19.85	19.96		25.93		23.99	24.99		22.78
FRI	18.43			19.83	21.45		20.06	24.04	25.24	25.54		19.12
SAT	13.27	15.06	18.17	19.76	18.28		18.40	20.08	22.62	13.45	16.70	19.33
SUN	14.28	12.49	13.45	14.12	18.44	18.23	14.69	19.97	20.32	21.10	12.78	19.00
MON	18.52	18.29	17.27	18.20	17.75	26.46	23.47	11.87	22.48	24.35	18.26	16.20
TUE	18.51	18.31	18.53	19.67	21.35	13.49	21.93	27.05	26.81	20.67	22.25	20.92
WED	18.44	18.45	19.62	19.46	21.62	30.74	18.57	20.45	23.56	21.41	19.65	20.76
THU	18.50	17.66	19.47	19.92	22.40	24.22	18.51	25.92	22.16	27.92	18.30	22.34
FRI	18.41	16.30	18.45	20.80	21.37	19.10	18.58	18.39	25.30	20.33	18.14	18.84
SAT	18.30	15.86	17.08	19.72	18.27	20.66	18.34	20.51	19.68	18.11	18.50	18.62
SUN	13.48	13.62	11.66	19.77	19.56	16.01	11.89	20.23	21.24	14.17	12.40	18.42
MON	18.23	18.22	19.42	19.51	19.45	24.96	18.42	26.25	21.31	15.34	22.54	18.62
TUE	18.60	18.44	19.33	19.49	26.51	27.00	18.19	18.06	24.89	18.00	19.76	19.62
WED	18.54	16.52	18.53	19.54	24.43	17.62	19.50	20.54	25.66	27.21	21.77	21.48
THU	21.45	18.53	19.44	18.45	18.72	25.18	19.00	23.32	24.92	25.12	18.10	21.86
FRI	18.14	18.75	19.23	21.80	22.83	19.09	18.06	22.43	18.89	20.45	18.31	18.11
SAT	15.75	18.27	17.99	19.45	19.45	18.71	20.77	21.88	18.66	18.48	18.44	18.30
SUN	13.25	10.80	14.07	16.50	18.04	18.74	21.38	20.28	25.42	13.41	14.66	14.96

TABLE 1.1 (cont'd.)

TREATED WATER - 1986

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
MON	18.58	19.91	19.63	19.47	10.94	16.22	21.91	24.84	19.80	18.43	20.99	21.06
TUE	18.62	20.67	19.60	19.54	20.78	22.90	27.32	26.56	23.53	20.93	19.85	19.46
WED	18.31	15.23	18.54	19.50	24.70	26.14	23.62	26.53	25.54	23.46	18.34	19.32
THU	18.64	18.58	19.72	18.40	19.29	17.43	23.32	20.04	22.67	18.91	25.58	9.02
FRI	18.45	18.62	19.70	21.60	19.42	25.78	23.38	27.11	24.47	26.33	18.18	9.09
SAT	12.58	18.29	19.75	19.53	18.30	19.62	22.80	21.24	17.90	16.95	18.26	16.62
SUN	14.37	15.04	19.25	14.52	19.31	16.96	20.42	20.53	21.71	13.62	17.88	11.62
MON	18.39	18.34	16.82	21.54	21.95	16.89	20.47	23.05	25.54	18.59	19.38	13.00
TUE	18.50	18.36	18.49	22.08	22.62	25.95	23.04	24.64	21.45	20.32	25.22	17.15
WED	18.58	18.37	19.51	19.47	18.27	19.31	20.48	22.60		20.97	18.20	19.37
THU	18.40	18.36	19.70		26.36	21.69	25.54	26.93		19.53	20.30	
FRI	18.44	18.26	19.61		24.60	23.03		21.73		23.06	23.94	
SAT			19.70		20.92	18.31		18.54			19.66	
SUN			15.31			18.86		12.57			12.82	
MON			16.93			13.76						
TUE												
MAX	21.45	20.67	19.75	23.29	26.51	30.74	27.32	27.11	28.10	27.92	25.58	22.78
MIN	12.58	10.80	13.45	14.12	10.94	13.49	11.89	11.87	16.72	13.41	12.40	9.02
AVG	17.31	17.27	18.19	19.48	20.56	20.77	20.65	21.87	22.88	20.43	18.97	18.34

TABLE 1.1: DAILY FLOWS (ML/d) 1985

MOE WPOS PROTOCOL

TREATED WATER

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
MON				18.63			17.83					
TUE	14.73			18.28			18.66			22.95		
WED	21.15			18.54	20.90		21.08			19.32		
THU	23.18			18.53	20.26		25.38	21.22		23.80		
FRI	23.18	23.18	23.18	18.35	18.21		24.52	25.42		20.81	19.80	
SAT	16.10	20.68	23.18	11.46	18.54	21.14	17.01	27.92		18.93	17.27	
SUN	21.26	17.04	21.64	12.85	18.38	18.80	12.70	20.18	19.14	18.81	13.21	14.04
MON	20.96	23.18	20.69	18.55	18.24	18.55	18.42	21.26	17.59	20.57	18.48	18.27
TUE	23.18	23.18	23.18	21.53	18.52	27.78	20.13	25.15	22.39	23.83	20.55	18.26
WED	23.18	23.18	23.18	18.45	20.27	21.64	16.42	24.84	22.35	18.01	21.40	18.34
THU	20.82	23.18	18.16	18.57	18.99	25.46	15.65	21.96	23.88	23.69	18.46	18.27
FRI	21.82	23.18	14.02	18.43	23.71	21.33	16.33	25.82	24.22	21.09	18.37	18.46
SAT	17.10	23.18	18.55	18.21	18.30	24.40	18.63	27.54	18.19	18.48	18.20	18.44
SUN	23.18	23.18	16.22	13.89	18.45	20.28	15.78	27.35	21.62	16.35	10.71	13.72
MON	23.18	23.18	18.31	18.72	18.37	23.85	16.38	22.63	21.45	15.38	17.52	18.28
TUE	23.18	22.99	18.33	18.53	24.02	25.25	17.84	27.10	24.58	18.43	23.21	18.36
WED	19.64	23.18	18.27	18.31	19.79	19.36	16.69	22.55	21.11	23.74	18.27	18.34
THU	23.18	23.18	18.35	23.30	18.38	22.34	15.35	25.15	24.43	21.31	19.44	21.48
FRI	23.18	28.25	18.32	20.12	18.28	18.66	21.92	20.30	18.28	18.08	18.30	18.43
SAT	22.89	23.18	18.23	18.39	18.30	20.76	19.27	18.93	19.04	18.71	18.01	13.22
SUN	18.59	16.77	13.68	12.80	13.33	18.34	18.07	19.23	19.05	18.21	14.93	14.81

TABLE 1.1 (cont'd.)

TREATED WATER - 1985

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
MON	20.53	23.18	18.51	19.74	14.31	18.15	20.22	21.08	21.25	18.05	18.31	18.54
TUE	23.18	26.68	18.27	22.56	18.45	18.70	24.55	26.30	21.68	18.73	18.40	18.44
WED	23.18	25.20	18.42	18.33	18.48	25.87	18.03	19.63	23.45	21.15	18.37	18.45
THU	23.18	23.18	18.58	23.90	20.85	18.09	22.66	24.48	19.81	19.62	18.44	18.35
FRI	32.15	23.18	18.75	18.41	24.17	18.66	23.02	24.53	23.51	21.41	20.09	18.40
SAT	20.41	22.99	18.42	18.54	18.99	18.62	19.53	19.04	19.29	19.35	18.22	18.02
SUN	14.28	19.28	12.59	12.11	18.21	19.46	23.89	19.35	19.86	15.48	17.74	10.94
MON	23.18	23.18	18.57	18.41	18.18	19.34	25.00	21.34	23.03	18.44	15.86	18.70
TUE	23.18	23.18	18.52	23.04	18.28	23.12	25.10	26.21	19.82	20.06	18.26	13.01
WED	23.09	25.70	18.43		25.03	18.36	18.08	20.16	22.14	22.30	18.39	13.84
THU	23.18	23.18	17.82		20.81	25.84		23.62	21.29	18.43	19.87	10.98
FRI			18.55		22.14	24.20		23.80	20.94		21.95	16.19
SAT			18.43			18.01		19.20	20.30		18.41	11.44
SUN			12.56			12.79			17.62			14.63
MON									20.80			15.77
TUE												13.35
MAX	32.15	28.25	23.18	23.90	25.03	25.87	25.38	27.92	24.58	23.83	23.21	21.48
MIN	14.28	16.77	12.59	11.46	13.33	12.79	12.70	18.93	17.59	15.33	10.71	10.94
AVG	21.72	22.96	18.45	18.31	19.39	20.90	19.49	23.01	21.07	19.79	18.28	16.44

TABLE 1.1: DAILY FLOWS (ML/d) 1984

TREATED WATER

MOE WPOS PROTOCOL

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
MON										20.90		
TUE					30.00					30.05		
WED		26.10			29.07			28.49		22.93		
THU		25.94	25.85		28.88			29.35		33.85	24.62	
FRI		26.02	26.14		29.60	18.20		26.70		25.33	23.09	
SAT		26.00	26.04		29.83	18.17		23.96	19.40	22.56	23.18	23.18
SUN	19.04	24.49	23.56	24.98	24.50	18.05	16.65	15.65	18.82	16.08	23.18	22.41
MON	21.76	25.90	26.27	22.91	29.35	18.02	16.41	18.97	23.36	15.58	20.50	20.28
TUE	25.68	25.69	26.30	26.21	23.87	19.83	22.52	20.21	28.38	18.67	23.18	23.18
WED	25.54	25.83	23.77	26.15	18.38	28.19	23.32	29.05	30.63	18.73	23.18	23.18
THU	26.05	25.67	27.63	25.73	18.58	20.98	25.64	26.39	23.36	18.89	26.22	22.89
FRI	25.92	25.85	26.33	26.45	18.58	18.18	18.15	33.53	23.36	33.79	25.83	23.18
SAT	25.89	25.97	26.21	26.36	18.40	18.30	17.70	23.30	19.61	18.46	17.30	23.18
SUN	18.70	26.25	20.38	26.40	18.41	20.65	8.80	18.67	19.42	14.68	19.49	17.78
MON	25.12	25.40	25.94	24.50	17.86	24.81	18.20	21.03	18.97	25.38	23.76	23.18
TUE	28.05	26.45	26.32	26.78	18.15	21.18	17.18	25.99	19.08	23.18	23.18	23.18
WED	28.27	29.38	26.23	27.25	18.14	28.68	23.69	28.21	30.00	23.37	27.14	23.18
THU	25.50	27.90	26.04	27.02	23.39	18.98	23.50	19.03	21.02	29.11	23.44	23.18
FRI	25.47	26.09	26.38	27.22	18.27	23.71	16.19	24.08	28.12	23.09	23.18	23.18
SAT	25.36	24.81	25.52	26.84	18.29	18.40	17.52	27.58	27.59	23.28	23.18	23.18
SUN	21.02	26.21	23.22	28.30	12.40	16.38	16.94	18.27	22.70	19.18	18.64	18.37

TABLE 1.1 (cont'd.)

TREATED WATER - 1984

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
MON	25.53	26.28	26.33	30.53	19.13	21.43	19.67	22.01	25.19	23.18	23.18	23.18
TUE	27.87	26.20	25.78	30.93	18.33	28.71	21.11	35.64	35.19	23.18	23.18	23.18
WED	27.49	26.33	26.16	31.35	19.34	24.11	23.24	20.23	23.52	24.12	23.18	23.18
THU	25.26	25.72	25.94	30.53	18.51	23.56	18.00	28.07	30.13	26.42	28.61	23.18
FRI	27.76	26.19	26.55	30.46	18.45	33.51	18.51	21.87	19.44	23.18	25.13	23.09
SAT	25.69	25.95	26.18	26.31	18.20	19.04	18.25	19.58	24.82	23.18	19.64	23.18
SUN	25.88	22.66	26.43	23.12	18.14	17.88	18.23	19.45	21.54	20.58	20.55	12.48
MON	26.00	25.85	26.47	25.90	17.92	18.48	21.42	20.74	30.59	23.18	23.18	22.32
TUE	26.28	17.21	26.09	29.87	18.33	27.32	34.44	20.58	33.39	23.18	23.18	12.27
WED	25.48	25.98	26.26	30.57	17.95	24.77	18.42	26.79	29.63	29.63	23.18	16.77
THU	28.21		26.81	30.20	18.28	24.58	23.15	29.61	33.96		23.18	15.68
FRI	25.02		26.38	30.32		21.86	21.16	19.27	19.16		23.18	19.14
SAT	26.14		26.20	30.21		18.53	18.27		19.20			12.27
SUN	22.90			29.12			18.26		19.13			20.05
MON	26.00			30.01			26.89					18.87
TUE	25.79						21.49					
MAX	28.27	29.38	27.63	31.35	30.00	33.51	34.44	35.64	35.19	33.85	28.61	23.18
MIN	18.70	17.21	20.38	22.91	12.40	16.38	8.80	15.65	18.82	14.68	17.30	12.27
AVG	25.29	25.66	25.80	27.75	20.85	21.82	20.09	23.94	24.29	23.12	23.06	20.83

TABLE 2

WATER PLANT OPTIMIZATION STUDY

"PARTICULATE REMOVAL SUMMARY"

TABLE 2.0: PARTICULATE REMOVAL SUMMARY

MOE WPOS PROTOCOL

				1986			1985			1984			1983		
				MAX.	MIN.	AVG.	MAX.	MIN.	AVG.	MAX.	MIN.	AVG.	MAX.	MIN.	AVG.
JAN	Turbidity (FTU)		R	36.0	5.7	13.3	153.0	10.0	54.0	15.3	3.9	8.3			
			T	0.17	0.09	0.13	1.09	0.10	0.18	0.15	0.10	0.12			
	Prime Coagulant	(mg/L)		17.3	10.3	12.8	38.9	9.2	20.1	12.7	6.6	9.1			
	Coagulant Aid	(mg/L)													
	Filter Aid	(mg/L)													
	Metal Res. Al	(mg/L)	R	0.04	0.01	0.02	0.02	0	0.02	0.06	0.02	0.04			
			T	0.02	0.01	0.02	0.01	0	0.01	0.07	0.02	0.04			
	pH		R	8.43	7.90	8.22	8.25	7.68	7.98	8.18	7.98	8.06			
			T	7.82	7.41	7.59	7.61	6.98	7.29	7.58	7.39	7.50			
	Temperature	(^{o}C)	R	6	3	4.2	5	2	3.3	5	2	3			
FEB	Turbidity (FTU)		R	9.8	5.1	6.5	28.0	3.8	6.3	72.4	3.5	14.5			
			T	0.22	0.13	0.17	0.23	0.15	0.19	0.27	0.12	0.16			
	Prime Coagulant	(mg/L)		13.4	8.5	10.6	15.1	7.3	8.4	28.7	7.0	11.8			
	Coagulant Aid	(mg/L)													
	Filter Aid	(mg/L)													
	Metal Res. Al	(mg/L)	R	0.02	0.01	0.02	0.03	0.01	0.02	0.02	0	0.01			
			T	0.03	0.01	0.02	0.02	0.01	0.02	0.05	0	0.02			
	pH		R	8.57	7.76	8.28	8.39	7.84	8.06	8.22	7.77	8.06			
			T	7.80	7.22	7.56	8.18	7.17	7.47	7.60	7.10	7.34			
	Temperature	(^{o}C)	R	7	3	4.8	6	3	3.6	5	3	4			
MAR	Turbidity (FTU)		R	246.2	3.4	29.5	224.0	9.2	56.6	86.0	4.7	20.9			
			T	0.17	0.07	0.12	0.69	0.12	0.21	0.31	0.11	0.17			
	Prime Coagulant	(mg/L)		51.9	12.1	22.8	47.5	10.9	24.3	30.6	8.5	16.7			
	Coagulant Aid	(mg/L)													
	Filter Aid	(mg/L)													
	Metal Res. Al	(mg/L)	R	0.02	0	0.01	0.03	0.01	0.015	0.01	0	0.01			
			T	0.02	0.01	0.02	0.02	0.01	0.013	0.02	0.01	0.02			
	pH		R	8.58	7.98	8.33	8.14	7.76	8.03	8.46	7.48	8.23			
			T	7.67	7.32	7.50	7.54	7.06	7.32	8.05	7.09	7.38			
	Temperature	(^{o}C)	R	8	4	6	8	3	5	6	3	4			

TABLE 2.0 (cont'd.)

				1986			1985			1984			1983		
				MAX.	MIN.	AVG.	MAX.	MIN.	AVG.	MAX.	MIN.	AVG.	MAX.	MIN.	AVG.
APR	Turbidity (FTU)		R	50.5	10.7	21.6	424.0	13.7	89.6	180.0	9.8	43.9			
			T	0.12	0.05	0.07	0.28	0.11	0.16	0.17	0.10	0.14			
	Prime Coagulant	(mg/L)		24.4	7.9	16.4	68.6	9.6	28.4	28.7	11.0	19.3			
	Coagulant Aid	(mg/L)													
	Filter Aid	(mg/L)													
	Metal Res. Al	(mg/L)	R	0.04	0	0.02	0.08	0.02	0.03	0.01	0	0.01			
			T	0.03	0	0.01	0.01	0	0.01	0.02	0	0.01			
	pH		R	8.29	7.92	8.13	8.46	7.94	8.11	8.22	7.76	8.06			
			T	7.70	7.38	7.52	7.68	7.17	7.39	7.41	6.94	7.26			
	Temperature	(^{o}C)	R	12	7	9.4	11	5	8	10	6	8			
MAY	Turbidity (FTU)		R	27.5	9.0	15.8	92.8	6.5	18.2	251.	12.3	39.6			
			T	0.14	0.06	0.08	0.17	0.10	0.14	0.18	0.11	0.14			
	Prime Coagulant	(mg/L)		16.3	8.0	10.5	20.5	8.4	11.5	40.5	9.1	16.5			
	Coagulant Aid	(mg/L)													
	Filter Aid	(mg/L)													
	Metal Res. Al	(mg/L)	R	0.05	0.01	0.03	0.04	0.01	0.02	0.04	0	0.01			
			T	0.04	0.02	0.03	0.02	0.01	0.01	0.03	0	0.01			
	pH		R	8.22	7.80	8.05	8.34	7.98	8.15	8.10	7.92	8.01			
			T	7.70	7.43	7.54	7.59	7.29	7.45	7.40	7.06	7.27			
	Temperature	(^{o}C)	R	16	10	13	15	9	12	13	9	11			
JUN	Turbidity (FTU)		R	72.3	12.3	29.1	72.5	10.4	21.4	85.3	8.3	23.0			
			T	0.14	0.08	0.10	0.18	0.12	0.15	0.21	0.12	0.16			
	Prime Coagulant	(mg/L)		24.1	8.2	12.8	23.1	10.2	13.4	20.3	7.3	11.3			
	Coagulant Aid	(mg/L)													
	Filter Aid	(mg/L)													
	Metal Res. Al	(mg/L)	R	0.04	0	0.02	0.03	0.02	0.023	–	–	–			
			T	0.03	0.01	0.02	0.02	0	0.008	0.03	0.01	0.02			
	pH		R	8.07	7.58	7.79	8.19	7.62	7.88	8.25	7.78	8.05			
			T	7.48	7.16	7.35	7.46	7.16	7.32	7.82	7.19	7.42			
	Temperature	(^{o}C)	R	16	12	13.9	17	11	13.9	19	11	14			

TABLE 2.0 (cont'd.)

				1986			1985			1984			1983		
				MAX.	MIN.	AVG.	MAX.	MIN.	AVG.	MAX.	MIN.	AVG.	MAX.	MIN.	AVG.
JUL	Turbidity (FTU)		R	78.3	8.3	26.8	40.0	8.6	19.0	60.7	8.2	24.8			
			T	0.11	0.07	0.08	0.19	0.11	0.14	0.27	0.11	0.18			
	Prime Coagulant	(mg/L)		23.7	9.3	14.2	17.4	9.1	12.5	19.9	8.4	14.6			
	Coagulant Aid	(mg/L)													
	Filter Aid	(mg/L)													
	Metal Res. Al	(mg/L)	R	0.02	0.01	0.02	0.04	0	0.01	0.02	0	0.01			
			T	0.03	0.02	0.03	0.02	0	0.01	0.02	0.01	0.02			
	pH		R	8.11	7.36	7.72	8.30	7.34	7.73	8.19	7.46	7.80			
			T	7.40	7.05	7.28	7.52	6.83	7.22	7.52	6.95	7.32			
	Temperature	(^{o}C)	R	20	14	18.2	21	14	17.2	20	13	15			
AUG	Turbidity (FTU)		R	57.0	5.8	16.5	48.7	2.7	20.5	31.0	9.1	15.9			
			T	0.11	0.07	0.09	0.22	0.12	0.16	0.20	0.11	0.14			
	Prime Coagulant	(mg/L)		22.0	7.5	11.4	18.3	8.1	12.6	18.6	10.7	12.8			
	Coagulant Aid	(mg/L)													
	Filter Aid	(mg/L)													
	Metal Res. Al	(mg/L)	R	0.03	0	0.02	0.03	0.02	0.025	0.03	0.02	0.03			
			T	0.03	0.02	0.03	0.03	0.01	0.018	0.03	0	0.02			
	pH		R	8.40	7.42	7.81	8.45	7.36	7.93	8.35	7.50	7.85			
			T	7.45	7.14	7.29	7.52	6.98	7.29	7.39	6.91	7.20			
	Temperature	(^{o}C)	R	24	19	21	23	19	21.5	24	18	21			
SEP	Turbidity (FTU)		R	195.0	10.0	33.5	120.2	7.7	24.7	139.2	5.6	35.2			
			T	0.13	0.07	0.10	0.19	0.13	0.16	0.22	0.09	0.15			
	Prime Coagulant	(mg/L)		36.7	10.0	14.6	25.6	8.5	12.2	37.7	7.1	16.1			
	Coagulant Aid	(mg/L)													
	Filter Aid	(mg/L)													
	Metal Res. Al	(mg/L)	R	0.04	0	0.02	0.03	0	0.01	0.02	0.01	0.02			
			T	0.04	0	0.02	0.03	0	0.01	0.01	0	0.01			
	pH		R	8.25	7.76	7.97	8.42	7.54	7.94	8.11	7.34	7.89			
			T	7.56	7.16	7.33	7.59	7.13	7.32	7.50	7.01	7.24			
	Temperature	(^{o}C)	R	21	18	19.5	22	20	21	20	16	19			

TABLE 2.0 (cont'd.)

Month	Parameter	Unit		1986 MAX.	1986 MIN.	1986 AVG.	1985 MAX.	1985 MIN.	1985 AVG.	1984 MAX.	1984 MIN.	1984 AVG.	1983 MAX.	1983 MIN.	1983 AVG.
OCT	Turbidity (FTU)		R	174.7	9.51	50.1	210.8	19.2	53.6	89.7	6.6	29.8			
			T	0.12	0.08	0.09	0.18	0.11	0.14	0.24	0.13	0.17			
	Prime Coagulant	(mg/L)		33.5	10.3	18.2	32.3	10.2	16.9	19.0	6.3	11.0			
	Coagulant Aid	(mg/L)													
	Filter Aid	(mg/L)													
	Metal Res. Al	(mg/L)	R	0.04	0	0.02	0.05	0.01	0.025	0.03	0	0.01			
			T	0.03	0	0.02	0.04	0	0.025	0.03	0	0.02			
	pH		R	8.46	7.76	8.13	8.26	7.98	8.12	8.15	7.83	8.01			
			T	7.54	7.23	7.42	7.52	7.24	7.42	7.55	7.27	7.40			
	Temperature	(^{o}C)	R	20	15	16.5	20	15	16.8	18	15	16.3			
NOV	Turbidity (FTU)		R	108.0	23.7	49.3	162.5	31.3	91.5	214.	26.2	86.7			
			T	0.11	0.08	0.09	0.21	0.09	0.13	0.18	0.10	0.14			
	Prime Coagulant	(mg/L)		25.2	13.5	18.3	28.0	13.0	20.6	24.7	7.9	16.7			
	Coagulant Aid	(mg/L)													
	Filter Aid	(mg/L)													
	Metal Res. Al	(mg/L)	R	0.05	0	0.02	0.06	0.03	0.04	0.03	0	0.02			
			T	0.02	0.01	0.02	0.04	0.01	0.03	0.01	0	0			
	pH		R	8.42	8.00	8.16	8.35	7.78	8.16	8.12	7.58	7.94			
			T	7.58	7.29	7.45	7.69	7.02	7.51	7.52	7.31	7.40			
	Temperature	(^{o}C)	R	15	8	11.8	15	9	12.4	15	9	11.3			
DEC	Turbidity (FTU)		R	223.0	22.5	89.7	219.2	15.8	81.9	159.0	20.0	69.4			
			T	0.16	0.06	0.09	0.19	0.09	0.12	0.39	0.12	0.18			
	Prime Coagulant	(mg/L)		33.1	15.0	22.8	34.3	8.8	20.4	29.7	8.7	17.3			
	Coagulant Aid	(mg/L)													
	Filter Aid	(mg/L)													
	Metal Res. Al	(mg/L)	R	0.02	0	0.01	0.04	0.01	0.03	0.02	0	0.01			
			T	0.02	0	0.01	0.02	0	0.01	0.04	0	0.01			
	pH		R	8.19	7.87	8.06	8.33	8.02	8.16	8.06	7.64	7.85			
			T	7.50	7.20	7.40	7.76	7.39	7.59	7.52	7.27	7.37			
	Temperature	(^{o}C)	R	10	6	7.3	10	3	6.4	9	5	7			

TABLE 2.1: PARTICULATE REMOVAL PROFILE JANUARY 1986.

MOE WPOS PROTOCOL

DATE	TURBIDITY (FTU) Raw	Set.	Filter	Treat.	COAGULANT ALUM mg/L	COAG. AID mg/L	FILTER AID mg/L	METAL RES. Al (mg/L) Raw	Treat.	pH Raw	pH Treat.	TEMP. (°C) Raw
1	22.2	9.7	.15	.15	10.3					8.11	7.65	3
2	21.0	8.3	.15	.15	13.1					8.09	7.74	4
3	17.5	7.2	.11	.11	14.3					7.90	7.57	4
4	13.5	6.6	.09	.10	10.7					8.33	7.74	4
5	15.8	6.5	.11	.12	12.7					8.19	7.82	4
6	36.0	7.2	.11	.12	15.7					8.25	7.55	4
7	13.5	5.3	.09	.09	11.6					8.43	7.58	3
8	11.8	4.8	.11	.11	12.4					8.28	7.52	3
9	12.2	4.7	.12	.12	12.5					8.14	7.66	4
10	9.5	4.3	.11	.11	11.2					8.24	7.62	4
11	10.1	5.7	.12	.12	11.2					8.28	7.59	4
12	7.5	3.6	.12	.12	11.2					8.19	7.53	5
13	10.3	4.9	.13	.12	11.2			.01	.02	8.39	7.71	5
14	9.3	4.8	.11	.11	11.3					8.19	7.47	3
15	8.7	4.5	.11	.10	11.2					8.21	7.47	3

DATE	TURBIDITY (FTU)				COAGULANT ALUM	COAG. AID	FILTER AID	METAL RES. Al (mg/L)		pH		TEMP. (oC)
	Raw	Set.	Filter	Treat.	mg/L	mg/L	mg/L	Raw	Treat.	Raw	Treat.	Raw
16	8.2	4.6	.11	.11	11.3					8.19	7.62	4
17	7.7	4.5	.11	.12	11.3					8.24	7.69	3
18	6.7	3.9	.14	.14	11.0					8.35	7.62	4
19	6.2	2.9	.10	.11	10.9					8.06	7.48	4
20	5.7	4.2	.15	.13	10.4			.01	.02	8.23	7.70	6
21	15.1	6.7	.13	.14	14.6					8.22	7.66	5
22	22.8	8.2	.12	.12	16.3					8.40	7.68	5
23	18.0	7.1	.12	.13	14.7					8.43	7.41	5
24	23.8	8.1	.15	.16	17.3					8.20	7.64	6
25	17.5	5.6	.10	.13	15.9					8.23	7.56	3
26	16.2	6.2	.15	.16	15.3					8.19	7.48	5
27	12.0	5.3	.13	.13	15.3			.04	.01	8.21	7.47	4
28	9.5	5.0	.12	.12	13.0					8.19	7.55	5
29	9.4	4.8	.13	.13	13.0					8.12	7.52	5
30	7.1	4.0	.13	.17	12.9					8.15	7.56	5
31	6.4	3.3	.13	.13	12.9					8.09	7.47	4

TABLE 2.1: PARTICULATE REMOVAL PROFILE FEBRUARY 1986

MOE WPOS PROTOCOL

DATE	TURBIDITY (FTU)				COAGULANT ALUM	COAG. AID	FILTER AID	METAL RES. Al (mg/L)		pH		TEMP. (°C)
	Raw	Set.	Filter	Treat.	mg/L	mg/L	mg/L	Raw	Treat.	Raw	Treat.	Raw
1	5.4	3.4	.15	.15	9.7					8.10	7.42	3
2	6.1	4.6	.19	.21	10.2					8.14	7.49	3
3	7.3	5.2	.18	.17	10.8			.01	.01	8.32	7.63	7
4	7.0	4.5	.16	.17	12.4					8.45	7.72	5
5	6.9	4.5	.18	.19	12.5					8.43	7.69	4
6	6.5	4.5	.16	.18	12.3					7.92	7.22	5
7	9.8	4.4	.15	.16	11.3					7.76	7.30	4
8	7.9	5.1	.17	.17	9.9					7.85	7.32	5
9	5.1	4.4	.16	.16	8.5					7.88	7.48	5
10	5.5	4.0	.15	.16	8.9			.01	.01	8.34	7.54	3
11	7.2	5.0	.15	.18	10.0					8.13	7.48	4
12	7.1	4.3	.14	.16	10.1					8.41	7.54	4
13	6.1	4.1	.13	.14	9.7					8.48	7.61	5
14	7.1	4.7	.19	.20	9.6					8.08	7.58	5
15	7.0	5.2	.19	.20	9.8					8.56	7.72	4

TABLE 2.1 (cont'd.) FEBRUARY 1986

DATE	TURBIDITY (FTU)				COAGULANT	COAG. AID	FILTER AID	METAL RES. Al (mg/L)		pH		TEMP. (oC)
	Raw	Set.	Filter	Treat.	ALUM mg/L	mg/L	mg/L	Raw	Treat.	Raw	Treat.	Raw
16	6.2	4.8	.20	.20	8.6					8.56	7.76	5
17	9.4	6.3	.23	.22	9.9			.02	.03	8.57	7.58	4
18	6.6	5.9	.21	.22	9.8					8.46	7.63	5
19	6.0	4.7	.18	.19	9.6					8.41	7.65	6
20	4.8	3.9	.14	.16	10.8					8.54	7.61	5
21	5.3	4.0	.14	.13	11.3					8.50	7.70	4
22	5.1	3.5	.16	.16	11.1					8.33	7.69	5
23	6.1	4.0	.15	.14	11.1					8.37	7.80	6
24	6.4	5.0	.15	.14	11.7			.02	.01	8.18	7.42	5
25	5.2	4.0	.14	.14	10.8					8.08	7.39	5
26	6.0	4.6	.15	.15	11.2					8.06	7.43	5
27	6.6	5.2	.22	.22	13.4					8.47	7.63	6
28	5.1	4.7	.15	.17	13.0					8.54	7.63	6
29												
30												
31												

TABLE 2.1: PARTICULATE REMOVAL PROFILE MARCH 1986

MOE WPOS PROTOCOL

DATE	TURBIDITY (FTU)				COAGULANT ALUM	COAG. AID	FILTER AID	METAL RES. Al (mg/L)		pH		TEMP. (°C)
	Raw	Set.	Filter	Treat.	mg/L	mg/L	mg/L	Raw	Treat.	Raw	Treat.	Raw
1	4.9	3.8	.16	.17	13.0					8.51	7.67	5
2	3.4	2.7	.16	.16	12.1					8.47	7.61	5
3	5.2	3.5	.13	.13	13.3			0	.02	8.43	7.65	5
4	4.2	3.2	.13	.13	13.8					8.52	7.57	5
5	4.2	2.9	.15	.15	15.3					8.48	7.66	5
6	3.9	2.8	.15	.14	17.0					8.45	7.55	6
7	4.5	2.7	.12	.13	16.6					8.48	7.54	6
8	5.6	2.7	.10	.12	16.7					8.38	7.46	5
9	4.0	2.0	.11	.12	14.5					8.12	7.41	6
10	4.5	2.8	.11	.12	13.9			.02	.01	8.31	7.66	5
11	7.7	2.9	.11	.13	18.5					8.51	7.48	5
12	45.8	9.5	.08	.17	27.8					8.58	7.62	6
13	12.5	5.1	.17	.12	23.2					8.51	7.42	6
14	9.5	4.3	.10	.11	22.3					8.47	7.44	8
15	10.2	3.9	.09	.10	23.9					8.44	7.42	6

TABLE 2.1 (cont'd.) MARCH 1986

DATE	TURBIDITY (FTU)				COAGULANT ALUM	COAG. AID	FILTER AID	METAL RES. Al (mg/L)		pH		TEMP. (oC)
	Raw	Set.	Filter	Treat.	mg/L	mg/L	mg/L	Raw	Treat.	Raw	Treat.	Raw
16	9.2	3.3	.10	.11	23.7					8.39	7.39	5
17	13.2	4.2	.12	.12	24.0					8.23	7.39	5
18	23.0	8.0	.14	.15	24.6			.01	.02	8.12	7.45	5
19	12.4	3.9	.12	.14	21.8					8.20	7.48	7
20	28.6	6.4	.11	.12	27.2					8.28	7.45	6
21	41.3	7.6	.13	.14	33.1					8.24	7.32	4
22	24.3	6.3	.14	.14	27.9					8.18	7.45	5
23	19.7	6.9	.10	.11	26.2					8.26	7.34	5
24	15.8	4.9	.09	.09	20.2			.02	.01	8.34	7.41	6
25	13.7	4.9	.06	.07	16.2					8.36	7.49	6
26	43.5	8.7	.09	.10	21.9					8.37	7.56	5
27	33.7	6.3	.11	.10	24.0					8.28	7.45	5
28	46.3	7.2	.08	.09	23.9					8.13	7.47	6
29	191.0	9.6	.07	.07	44.6					8.02	7.54	5
30	246.2	12.6	.08	.09	51.9					7.98	7.52	6
31	95.0	8.9	.04	.07	30.5			.02	.02	8.19	7.50	5

TABLE 2.1: PARTICULATE REMOVAL PROFILE APRIL 1986

MOE WPOS PROTOCOL

DATE	TURBIDITY (FTU)				COAGULANT ALUM	COAG. AID	FILTER AID	METAL RES. Al (mg/L)		pH		TEMP. (°C)
	Raw	Set.	Filter	Treat.	mg/L	mg/L	mg/L	Raw	Treat.	Raw	Treat.	Raw
1	50.5	8.5	.09	.09	24.4					8.14	7.38	9
2	25.3	5.7	.10	.12	20.3					8.18	7.40	8
3	26.0	5.8	.08	.08	20.7					8.10	7.42	8
4	21.7	4.9	.08	.08	19.8					8.12	7.60	7
5	23.2	4.6	.07	.08	19.9					8.12	7.70	9
6	34.3	5.3	.06	.08	22.2					8.13	7.51	10
7	30.0	6.3	.08	.08	22.1			0	.01	8.19	7.46	10
8	24.7	6.2	.08	.09	21.3					8.13	7.44	10
9	26.3	8.0	.08	.08	16.0					8.10	7.50	8
10	28.8	6.6	.08	.08	14.4					7.96	7.50	8
11	17.2	5.0	.07	.07	14.0					8.27	7.52	9
12	10.8	3.5	.06	.06	13.2					8.07	7.57	9
13	24.3	4.5	.07	.07	16.6					8.10	7.52	9
14	16.8	4.1	.07	.07	15.2			.02	0	8.18	7.49	9
15	29.2	3.6	.07	.07	18.0					8.10	7.42	8

TABLE 2.1 (cont'd.) APRIL 1986

DATE	TURBIDITY (FTU)				COAGULANT ALUM	COAG. AID	FILTER AID	METAL RES. Al (mg/L)		pH		TEMP. (oC)
	Raw	Set.	Filter	Treat.	mg/L	mg/L	mg/L	Raw	Treat.	Raw	Treat.	Raw
16	25.7	4.4	.06	.06	18.9					8.21	7.58	8
17	12.4	3.0	.05	.05	14.0					8.26	7.58	11
18	19.3	4.2	.07	.07	15.2					8.20	7.61	11
19	23.0	4.9	.06	.06	16.2					8.22	7.54	10
20	17.0	4.0	.05	.06	15.9					8.13	7.47	10
21	16.0	3.7	.06	.06	15.8			.03	.01	8.14	7.43	10
22	14.0	3.6	.06	.06	14.7					7.95	7.46	9
23	12.7	3.6	.06	.05	12.7					8.12	7.52	9
24	15.5	4.1	.06	.06	11.9					7.96	7.54	10
25	20.0	6.1	.11	.11	13.3					8.20	7.65	10
26	19.5	4.0	.07	.07	15.3					8.18	7.48	10
27	16.3	4.2	.07	.07	14.7					7.92	7.40	10
28	20.2	4.6	.07	.08	16.4					8.02	7.49	10
29	17.0	4.3	.07	.07	11.9			.04	.03	8.09	7.60	11
30	10.7	3.7	.08	.06	7.9					8.29	7.68	12
31												

TABLE 2.1: PARTICULATE REMOVAL PROFILE MAY 1986

MOE WPOS PROTOCOL

DATE	TURBIDITY (FTU)				COAGULANT ALUM	COAG. AID	FILTER AID	METAL RES. Al (mg/L)		pH		TEMP. (°C)
	Raw	Set.	Filter	Treat.	mg/L	mg/L	mg/L	Raw	Treat.	Raw	Treat.	Raw
1	13.2	4.4	.09	.08	9.1					8.15	7.70	12
2	19.8	4.3	.08	.07	11.0					8.06	7.60	10
3	9.6	3.5	.07	.07	8.6					8.21	7.70	10
4	14.2	3.5	.07	.07	9.3					8.05	7.53	10
5	14.9	4.5	.08	.09	8.0			.02	.02	8.05	7.62	10
6	12.7	4.4	.09	.10	8.3					8.12	7.60	10
7	25.0	4.3	.08	.08	11.3					8.10	7.65	11
8	17.8	4.5	.09	.08	9.4					8.22	7.70	12
9	15.7	4.2	.08	.08	9.3					8.15	7.58	12
10	15.2	3.9	.07	.07	9.2					8.16	7.61	12
11	13.3	4.2	.07	.07	8.4					8.11	7.58	13
12	13.3	4.1	.09	.09	8.5			.05	.04	8.05	7.57	12
13	20.0	3.3	.08	.09	12.3					8.15	7.51	12
14	16.0	3.1	.07	.07	11.2					8.14	7.52	13
15	16.0	2.8	.07	.07	12.2					8.04	7.52	13

TABLE 2.1 (cont'd.) MAY 1986

DATE	TURBIDITY (FTU)				COAGULANT ALUM	COAG. AID	FILTER AID	METAL RES. Al (mg/L)		pH		TEMP. (oC)
	Raw	Set.	Filter	Treat.	mg/L	mg/L	mg/L	Raw	Treat.	Raw	Treat.	Raw
16	27.5	3.6	.06	.07	16.3					8.09	7.55	14
17	12.5	2.7	.06	.06	11.8					8.07	7.51	13
18	14.2	3.2	.06	.07	11.3					7.97	7.58	14
19	13.3	2.3	.06	.08	11.1			.01	.02	8.12	7.44	14
20	24.5	3.5	.07	.08	13.9					8.12	7.47	14
21	25.6	3.6	.06	.07	14.2					8.12	7.48	13
22	13.3	2.9	.05	.06	10.7					8.02	7.51	14
23	10.5	2.9	.06	.06	10.2					7.98	7.49	14
24	10.4	3.1	.08	.08	9.3					8.01	7.60	14
25	9.0	2.7	.07	.07	9.7					7.80	7.43	14
26	10.0	2.8	.07	.08	9.6			.04	.03	7.85	7.43	13
27	16.0	3.6	.08	.08	10.8					7.86	7.44	15
28	17.3	3.6	.08	.08	10.3					7.95	7.52	16
29	20.5	4.6	.08	.08	12.2					7.87	7.47	15
30	14.2	5.2	.16	.14	9.2					7.90	7.50	14
31	15.0	3.8	.08	.09	9.6					7.95	7.48	13

TABLE 2.1: PARTICULATE REMOVAL PROFILE JUNE 1986

MOE WPOS PROTOCOL

DATE	TURBIDITY (FTU)				COAGULANT ALUM	COAG. AID	FILTER AID	METAL RES. Al (mg/L)		pH		TEMP. (°C)
	Raw	Set.	Filter	Treat.	mg/L	mg/L	mg/L	Raw	Treat.	Raw	Treat.	Raw
1	20.8	4.6	.08	.09	11.4					7.98	7.44	13
2	26.8	5.5	.09	.09	16.1			.02	.01	7.92	7.46	14
3	51.3	4.5	.07	.08	19.0					7.94	7.26	14
4	24.8	5.2	.07	.08	14.0					7.81	7.28	14
5	26.2	5.0	.07	.08	11.5					7.76	7.31	14
6	17.0	4.1	.08	.08	11.0					8.07	7.35	14
7	30.0	4.9	.09	.09	13.3					7.68	7.26	13
8	16.0	4.9	.11	.09	9.6					7.74	7.30	12
9	12.7	4.3	.10	.11	8.2			.02	.02	7.68	7.25	12
10	12.3	4.0	.08	.10	9.8					7.72	7.29	12
11	18.3	4.2	.09	.10	9.9					7.72	7.37	15
12	18.8	4.2	.09	.09	9.4					7.76	7.38	16
13	33.0	5.5	.09	.09	11.0					7.68	7.32	14
14	18.8	5.7	.13	.12	8.8					7.98	7.45	13
15	21.7	4.9	.11	.12	10.2					7.73	7.48	13

TABLE 2.1 (cont'd.) JUNE 1986

DATE	TURBIDITY (FTU)				COAGULANT ALUM	COAG. AID	FILTER AID	METAL RES. Al (mg/L)		pH		TEMP. (oC)
	Raw	Set.	Filter	Treat.	mg/L	mg/L	mg/L	Raw	Treat.	Raw	Treat.	Raw
16	29.0	4.7	.07	.09	13.5					7.88	7.43	15
17	30.2	5.6	.08	.09	12.5			.04	.02	7.86	7.39	14
18	18.0	5.1	.09	.10	10.0					7.85	7.44	14
19	17.0	5.8	.12	.12	8.7					7.75	7.41	14
20	35.0	6.3	.11	.12	13.9					7.82	7.46	13
21	42.3	6.4	.12	.14	13.6					7.90	7.31	14
22	37.8	6.0	.08	.10	14.3					7.74	7.38	15
23	39.0	6.3	.07	.08	13.3			.03	.02	7.90	7.38	15
24	27.3	6.4	.09	.10	12.9					7.76	7.32	13
25	19.8	4.9	.09	.09	9.7					7.75	7.37	14
26	28.2	6.2	.12	.13	9.7					7.79	7.38	14
27	36.0	5.7	.08	.10	17.1					7.58	7.16	15
28	72.3	5.5	.09	.09	24.1					7.58	7.25	15
29	57.5	5.9	.08	.09	22.1					7.60	7.32	15
30	36.0	4.9	.08	.08	16.7			0	.03	7.73	7.33	14
31												

TABLE 2.1: PARTICULATE REMOVAL PROFILE JULY 1986

MOE WPOS PROTOCOL

DATE	TURBIDITY (FTU)				COAGULANT ALUM	COAG. AID	FILTER AID	METAL RES. Al (mg/L)		pH		TEMP. (°C)
	Raw	Set.	Filter	Treat.	mg/L	mg/L	mg/L	Raw	Treat.	Raw	Treat.	Raw
1	35.0	5.0	.08	.08	17.4					7.78	7.31	14
2	34.0	5.5	.08	.08	16.7					7.81	7.35	15
3	34.8	5.6	.08	.09	16.4					7.65	7.33	15
4	35.5	5.4	.09	.09	15.5					7.84	7.21	15
5	78.3	5.3	.10	.10	23.7					7.56	7.24	14
6	62.7	4.4	.07	.07	23.1					7.86	7.40	15
7	54.0	5.7	.07	.08	21.2			.01	.02	7.77	7.38	16
8	35.5	5.2	.07	.08	17.5					7.84	7.32	16
9	26.7	3.9	.07	.08	15.2					7.79	7.24	17
10	20.5	4.0	.07	.07	13.0					7.70	7.24	17
11	20.2	4.3	.09	.09	12.8					7.70	7.25	18
12	25.0	4.2	.10	.11	14.7					7.92	7.05	17
13	17.0	2.5	.08	.08	13.8					7.85	7.25	18
14	29.0	3.6	.08	.09	14.4					8.00	7.29	20
15	24.0	3.7	.08	.08	14.2					8.11	7.38	20

TABLE 2.1 (cont'd.) JULY 1986

DATE	TURBIDITY (FTU)				COAGULANT ALUM	COAG. AID	FILTER AID	METAL RES. Al (mg/L)		pH		TEMP. (oC)
	Raw	Set.	Filter	Treat.	mg/L	mg/L	mg/L	Raw	Treat.	Raw	Treat.	Raw
16	20.5	3.0	.07	.07	13.0					7.90	7.25	20
17	21.5	3.4	.07	.08	12.6					7.84	7.38	20
18	24.0	3.7	.02	.07	12.5					7.84	7.33	20
19	20.7	4.2	.07	.07	11.5					7.80	7.31	20
20	17.3	3.9	.08	.09	13.3					7.79	7.31	20
21	14.2	3.6	.08	.08	10.0			.02	.03	7.69	7.34	20
22	16.5	3.9	.07	.08	10.9					7.76	7.26	20
23	15.3	3.5	.07	.07	11.6					7.64	7.31	20
24	14.0	3.9	.08	.08	11.0					7.65	7.34	19
25	16.8	4.6	.10	.10	11.5					7.52	7.24	20
26	24.3	4.8	.10	.10	12.7					7.61	7.17	19
27	24.3	4.3	.09	.08	12.3					7.59	7.16	20
28	30.2	5.0	.07	.08	15.3			.02	.03	7.36	7.16	20
29	20.7	4.9	.07	.08	13.8					8.03	7.29	20
30	8.3	2.9	.06	.07	10.3					7.56	7.27	19
31	10.4	3.5	.10	.09	9.3					7.56	7.28	20

TABLE 2.1: PARTICULATE REMOVAL PROFILE AUGUST 1986.

MOE WPOS PROTOCOL

DATE	TURBIDITY (FTU)				COAGULANT ALUM	COAG. AID	FILTER AID	METAL RES. Al (mg/L)		pH		TEMP. (°C)
	Raw	Set.	Filter	Treat.	mg/L	mg/L	mg/L	Raw	Treat.	Raw	Treat.	Raw
1	18.7	4.9	.09	.10	10.9					7.88	7.31	20
2	16.2	3.4	.07	.08	11.7					7.54	7.21	20
3	9.5	2.8	.06	.07	9.7					7.52	7.26	20
4	8.8	2.5	.07	.08	9.4			.03	.02	7.56	7.34	20
5	11.3	3.4	.09	.09	10.3					7.55	7.23	20
6	6.2	2.5	.08	.08	8.6					7.58	7.26	20
7	15.1	3.7	.09	.09	11.0					7.76	7.28	21
8	13.0	2.8	.09	.09	10.4					7.66	7.23	20
9	6.3	2.5	.09	.09	9.9					7.49	7.28	21
10	7.4	2.4	.08	.08	10.0					7.42	7.19	20
11	7.1	3.1	.07	.09	9.5			.02	.03	7.50	7.29	20
12	7.2	2.3	.08	.08	7.5					8.40	7.38	20
13	5.8	2.6	.08	.08	7.8					7.72	7.28	19
14	16.9	3.8	.10	.10	10.7					7.79	7.18	20
15	25.2	3.6	.09	.09	13.0					7.94	7.28	21

TABLE 2.1 (cont'd.) AUGUST 1986

DATE	TURBIDITY (FTU)				COAGULANT ALUM	COAG. AID	FILTER AID	METAL RES. Al (mg/L)		pH		TEMP. (oC)
	Raw	Set.	Filter	Treat.	mg/L	mg/L	mg/L	Raw	Treat.	Raw	Treat.	Raw
16	15.9	3.5	.09	.08	10.4					7.85	7.27	21
17	16.0	2.8	.09	.09	11.2					7.89	7.28	21
18	16.0	3.3	.08	.08	11.6			0	.02	8.11	7.32	22
19	9.0	3.4	.08	.08	10.5					8.26	7.37	23
20	17.5	3.7	.09	.08	12.1					8.21	7.41	24
21	17.8	3.8	.08	.11	11.7					8.08	7.40	24
22	21.0	4.7	.08	.09	12.7					7.95	7.45	23
23	18.2	3.3	.07	.08	12.5					7.96	7.28	23
24	18.8	2.5	.09	.09	11.7					7.92	7.28	24
25	21.3	2.9	.09	.09	13.9			.02	.03	7.92	7.36	23
26	39.8	3.9	.08	.08	15.3					8.14	7.41	22
27	57.0	3.7	.07	.08	22.0					8.12	7.41	22
28	26.0	4.7	.07	.07	15.2					7.54	7.16	22
29	13.0	3.1	.08	.08	11.6					7.45	7.14	20
30	16.0	2.8	.08	.08	11.3					7.62	7.25	19
31	12.0	2.5	.08	.09	10.2					7.66	7.23	19

TABLE 2.1: PARTICULATE REMOVAL PROFILE SEPTEMBER 1986

MOE WPOS PROTOCOL

DATE	TURBIDITY (FTU)				COAGULANT ALUM	COAG. AID	FILTER AID	METAL RES. Al (mg/L)		pH		TEMP. (°C)
	Raw	Set.	Filter	Treat.	mg/L	mg/L	mg/L	Raw	Treat.	Raw	Treat.	Raw
1	17.8	2.7	0.08	.08	13.4			.02	.02	7.60	7.16	19
2	19.7	3.6	0.10	.10	13.0					7.86	7.28	20
3	13.2	3.2	0.10	.11	10.8					8.17	7.56	21
4	49.5	3.7	0.09	.10	18.1					8.09	7.28	21
5	22.5	3.9	0.10	.12	12.7					7.98	7.29	21
6	15.2	3.3	0.12	.13	10.9					8.25	7.46	21
7	13.2	2.4	0.09	.09	10.0					8.14	7.43	21
8	15.0	3.0	0.11	.11	10.5			.03	.04	8.14	7.40	21
9	17.5	3.8	0.10	.11	12.2					7.86	7.31	20
10	16.0	3.6	0.10	.10	12.0					8.01	7.25	20
11	122.0	3.9	0.10	.10	29.6					7.97	7.27	20
12	195.0	4.5	0.08	.08	36.7					7.98	7.32	20
13	49.3	3.9	0.07	.07	19.5					7.82	7.31	20
14	27.3	3.6	0.07	.07	16.3					7.76	7.24	18
15	21.3	4.4	0.08	.08	13.0			.02	.03	7.81	7.26	18

TABLE 2.1 (cont'd.) SEPTEMBER 1986

DATE	TURBIDITY (FTU)				COAGULANT ALUM	COAG. AID	FILTER AID	METAL RES. Al (mg/L)		pH		TEMP. (oC)
	Raw	Set.	Filter	Treat.	mg/L	mg/L	mg/L	Raw	Treat.	Raw	Treat.	Raw
16	21.8	5.0	0.08	.09	12.5					7.96	7.40	18
17	29.7	4.5	0.09	.09	14.3					7.88	7.33	18
18	100.8	5.4	0.08	.08	25.4					8.01	7.28	18
19	58.0	4.6	0.08	.08	20.5					7.96	7.31	19
20	12.8	2.7	0.08	.09	11.3					7.98	7.36	19
21	11.7	2.4	0.09	.09	11.6					8.03	7.35	19
22	10.0	2.6	0.10	.10	10.4			.04	0	7.96	7.35	18
23	14.0	3.3	0.11	.11	10.7					7.94	7.29	19
24	12.0	3.2	0.10	.11	10.4					7.92	7.29	19
25	12.8	3.4	0.10	.10	10.4					7.77	7.24	18
26	20.2	4.2	0.09	.10	11.9					7.98	7.28	20
27	12.0	2.4	0.09	.10	10.9					8.18	7.40	20
28	13.5	2.8	0.09	.10	10.1					8.06	7.38	19
29	24.3	4.6	0.10	.10	14.4			0	.02	7.90	7.32	20
30	37.0	4.0	0.10	.10	15.6					8.05	7.40	20
31												

TABLE 2.1: PARTICULATE REMOVAL PROFILE OCTOBER 1986.

MOE WPOS PROTOCOL

DATE	TURBIDITY (FTU)				COAGULANT ALUM	COAG. AID	FILTER AID	METAL RES. Al (mg/L)		pH		TEMP. (°C)
	Raw	Set.	Filter	Treat.	mg/L	mg/L	mg/L	Raw	Treat.	Raw	Treat.	Raw
1	21.0	3.4	0.09	.10	13.5					7.82	7.33	20
2	20.3	4.2	0.08	.09	12.1					7.96	7.35	20
3	33.5	5.3	0.09	.09	17.4					7.87	7.32	20
4	71.0	5.1	0.09	.10	22.6					7.95	7.35	19
5	32.0	4.4	0.09	.09	16.5					8.02	7.32	19
6	84.0	8.1	0.11	.11	23.8			0	0	8.04	7.36	19
7	61.2	7.1	0.09	.11	22.3					7.92	7.39	18
8	133.0	5.3	0.11	.10	33.5					7.76	7.30	18
9	96.8	5.6	0.07	.08	24.5					8.14	7.23	18
10	57.8	7.4	0.09	.10	16.7					8.15	7.39	18
11	136.5	7.8	0.11	.12	24.5					8.12	7.49	17
12	174.7	6.2	0.10	.09	27.8					8.06	7.40	17
13	94.0	4.3	0.07	.08	28.4			.04	.02	8.17	7.41	18
14	51.2	4.5	0.08	.09	26.1					8.46	7.42	18
15	96.5	5.9	0.08	.08	27.7					8.26	7.42	18

TABLE 2.1 (cont'd.) OCTOBER 1986

DATE	TURBIDITY (FTU)				COAGULANT ALUM	COAG. AID	FILTER AID	METAL RES. Al (mg/L)		pH		TEMP. (oC)
	Raw	Set.	Filter	Treat.	mg/L	mg/L	mg/L	Raw	Treat.	Raw	Treat.	Raw
16	39.0	5.0	0.08	.08	18.1					8.21	7.38	16
17	41.0	5.7	0.09	.09	18.2					8.19	7.47	16
18	37.0	5.5	0.09	.09	18.2					8.10	7.48	16
19	24.0	3.4	0.08	.09	15.7					8.09	7.46	15
20	15.5	3.1	0.08	.08	12.2			.02	.02	8.32	7.52	16
21	23.2	3.8	0.09	.09	17.4					8.28	7.46	15
22	22.3	4.1	0.08	.09	13.7					8.12	7.44	16
23	13.8	3.3	0.08	.08	11.5					8.16	7.44	15
24	11.0	3.3	0.10	.10	10.4					8.10	7.46	16
25	9.5	2.7	0.09	.09	10.3					8.26	7.45	16
26	11.7	2.4	0.08	.09	11.5					8.24	7.48	16
27	15.0	3.4	0.10	.10	11.8			.03	.03	8.16	7.50	16
28	19.0	3.7	0.09	.09	12.0					8.24	7.52	16
29	43.0	4.8	0.09	.09	16.5					8.24	7.51	16
30	33.0	3.9	0.09	.09	16.7					8.21	7.53	15
31	31.5	5.0	0.09	.10	15.3					8.32	7.54	15

TABLE 2.1: PARTICULATE REMOVAL PROFILE NOVEMBER 1986

MOE WPOS PROTOCOL

DATE	TURBIDITY (FTU)				COAGULANT	COAG. AID	FILTER AID	METAL RES. Al/Fe (mg/L)		pH		TEMP. (°C)
	Raw	Set.	Filter	Treat.	mg/L	mg/L	mg/L	Raw	Treat.	Raw	Treat.	Raw
1	71.7	4.5	0.09	0.10	21.3					8.14	7.55	15
2	38.0	3.5	0.07	0.09	17.0					8.04	7.54	15
3	26.2	3.8	0.08	0.08	15.1			0.01	0.02	8.42	7.45	15
4	54.7	6.1	0.09	0.09	23.8					8.24	7.38	15
5	31.0	5.3	0.09	0.09	15.7					8.27	7.44	14
6	26.3	4.6	0.09	0.08	14.0					8.26	7.48	15
7	23.7	4.1	0.08	0.08	13.5					8.27	7.45	13
8	29.3	5.0	0.09	0.09	13.5					8.20	7.40	14
9	34.0	4.2	0.09	0.09	15.7					8.10	7.40	14
10	83.0	6.5	0.09	0.05	21.5			0.05	0.01	8.17	7.46	13
11	41.0	5.8	0.09	0.10	16.0					8.15	7.50	13
12	32.5	6.2	0.11	0.11	14.3					8.12	7.33	12
13	37.7	5.1	0.09	0.09	17.5			0.03		8.26	7.48	12
14	24.8	4.8	0.09	0.09	15.1					8.00	7.50	13
15	78.3	5.6	0.08	0.08	22.9					8.12	7.46	11

TABLE 2.1 (cont'd.) NOVEMBER 1986

DATE	TURBIDITY (FTU)				COAGULANT ALUM	COAG. AID	FILTER AID	METAL RES. Al/Fe (mg/L)		pH		TEMP. (oC)
	Raw	Set.	Filter	Treat.	mg/L	mg/L	mg/L	Raw	Treat.	Raw	Treat.	Raw
16	53.8	5.5	0.08	0.09	19.0					8.14	7.40	11
17	58.7	5.7	0.08	0.09	19.5			0.00	0.02	8.20	7.46	11
18	57.0	6.9	0.07	0.09	19.0					8.26	7.49	11
19	39.7	7.0	0.09	0.09	16.1					8.27	7.53	10
20	69.6	7.3	0.08	0.09	20.9					8.26	7.53	12
21	108.0	6.8	0.07	0.08	25.2					8.13	7.58	12
22	42.0	6.4	0.08	0.09	16.5					8.10	7.50	10
23	48.0	6.9	0.10	0.10	17.2					8.00	7.43	10
24	81.5	7.4	0.09	0.11	24.5			0.02	0.02	8.03	7.48	9
25	58.2	7.1	0.08	0.10	21.8					8.02	7.32	10
26	37.2	5.6	0.06	0.09	18.5					8.07	7.29	10
27	38.3	5.3	0.07	0.08	16.9					8.16	7.39	8
28	63.8	7.8	0.09	0.09	20.3					8.22	7.36	8
29	61.8	6.7	0.09	0.09	20.2					8.08	7.48	9
30	29.3	4.6	0.08	0.08	16.0					8.17	7.44	10
31												

TABLE 2.1: PARTICULATE REMOVAL PROFILE DECEMBER 1986

MOE WPOS PROTOCOL

DATE	TURBIDITY (FTU)				COAGULANT ALUM	COAG. AID	FILTER AID	METAL RES. Al/Fe (mg/L)		pH		TEMP. (°C)
	Raw	Set.	Filter	Treat.	mg/L	mg/L	mg/L	Raw	Treat.	Raw	Treat.	Raw
1	84.3	7.8	0.08	0.09	24.0			0.02	0.01	8.09	7.26	8
2	96.5	7.3	0.08	0.09	25.7					8.19	7.38	9
3	223.0	7.3	0.09	0.10	33.1					8.15	7.34	8
4	167.0	8.5	0.07	0.08	28.7					8.15	7.43	9
5	156.0	9.3	0.10	0.10	28.0					8.00	7.40	10
6	159.7	8.6	0.08	0.08	29.7					8.05	7.42	6
7	132.2	7.4	0.07	0.08	28.2					7.90	7.44	7
8	91.2	7.1	0.07	0.11	24.0					7.87	7.40	7
9	131.0	7.3	0.08	0.10	28.2					7.94	7.20	7
10	115.0	9.3	0.08	0.08	26.0					8.13	7.46	7
11	115.0	9.5	0.09	0.09	27.4					8.17	7.40	8
12	124.0	7.7	0.12	0.16	27.0					8.13	7.41	9
13	68.5	7.4	0.06	0.07	21.0					8.16	7.39	7
14	109.0	8.5	0.05	0.06	23.4					8.16	7.42	7
15	104.0	8.6	0.08	0.07	25.3			0	0.02	8.12	7.43	6

TABLE 2.1 (cont'd.) DECEMBER 1986

DATE	TURBIDITY (FTU)				COAGULANT	COAG. AID	FILTER AID	METAL RES. Al/Fe (mg/L)		pH		TEMP. (oC)
	Raw	Set.	Filter	Treat.	mg/L	mg/L	mg/L	Raw	Treat.	Raw	Treat.	Raw
16	64.0	9.1	0.10	0.10	20.1					8.12	7.41	6
17	46.0	9.4	0.08	0.08	17.0					8.11	7.43	6
18	59.7	10.0	0.07	0.08	21.4					7.96	7.42	7
19	68.5	8.8	0.11	0.11	21.4					7.99	7.36	7
20	38.8	6.6	0.09	0.09	17.9					8.02	7.29	7
21	48.0	7.1	0.07	0.08	19.1					8.10	7.40	7
22	57.0	9.7	0.09	0.09	22.3			0	0	8.06	7.38	7
23	87.0	7.9	0.07	0.07	23.2					7.88	7.44	7
24	97.0	9.4	0.07	0.07	24.2					8.07	7.38	8
25	93.5	7.3	0.10	0.11	24.0					8.09	7.48	8
26	53.2	6.7	0.07	0.10	16.7					7.95	7.50	7
27	47.3	7.9	0.07	0.07	16.6					8.17	7.47	6
28	38.5	7.2	0.08	0.08	15.0					8.09	7.46	6
29	47.7	8.2	0.09	0.10	16.7			0	0.02	8.10	7.46	6
30	36.3	7.2	0.08	0.08	15.7					8.11	7.45	8
31	22.5	5.9	0.06	0.08	15.3					7.96	7.40	8

TABLE 2.1: PARTICULATE REMOVAL PROFILE JANUARY 1985.

MOE WPOS PROTOCOL

DATE	TURBIDITY (FTU)				COAGULANT ALUM	COAG. AID	FILTER AID	METAL RES. Al (mg/L)		pH		TEMP. (°C)
	Raw	Set.	Filter	Treat.	mg/L	mg/L	mg/L	Raw	Treat.	Raw	Treat.	Raw
1	153.0	7.3	.14	.14	38.9					7.86	7.31	5
2	110.5	8.3	.15	.16	31.0					8.02	7.24	4
3	83.2	10.8	.18	.17	26.5					8.04	7.24	4
4	53.2	7.3	.12	.12	22.5					8.08	7.37	4
5	53.5	8.5	.20	.15	23.0					8.04	7.41	4
6	88.0	8.6	.24	.26	29.2					8.03	7.21	4
7	104.0	7.5	.11	.11	31.4			.02	0	8.00	7.24	5
8	103.7	8.3	.10	.10	30.1					8.02	7.34	4
9	56.0	7.8	.17	.16	22.5					7.98	7.34	4
10	49.3	8.5	.21	.22	18.6					8.15	7.46	3
11	52.7	10.1	.16	.16	19.2					7.73	7.08	3
12	44.5	8.6	.12	.12	19.9					7.88	7.39	4
13	98.8	8.5	.13	.13	26.9					7.98	7.29	3
14	117.7	10.1	.15	.17	28.5			.02	0	7.98	7.18	3
15	81.0	9.8	.14	.14	24.9					7.92	7.18	3

TABLE 2.1 (cont'd.) JANUARY 1985

DATE	TURBIDITY (FTU)				COAGULANT ALUM	COAG. AID	FILTER AID	METAL RES. Al (mg/L)		pH		TEMP. (oC)
	Raw	Set.	Filter	Treat.	mg/L	mg/L	mg/L	Raw	Treat.	Raw	Treat.	Raw
16	63.0	9.0	.13	.13	22.3					7.86	7.17	
17	42.7	8.4	.15	.15	19.8					7.93	7.26	
18	52.5	10.1	.16	.17	19.3					8.00	7.29	
19	49.5	8.0	.14	.12	17.2					8.00	7.30	
20	30.8	6.5	.11	.10	13.3					8.01	7.27	
21	22.2	7.7	.21	.21	11.1					7.91	7.35	
22	21.0	8.5	.19	.20	11.1					8.03	7.47	
23	20.2	9.0	.17	.19	11.4			0	.01	8.25	7.61	
24	26.2	8.6	.18	.18	12.4					7.68	6.98	
25	20.7	10.3	.40	1.09	16.8					8.01	7.24	
26	14.3	5.9	.12	.15	12.4					8.01	7.23	
27	13.7	4.6	.15	.15	15.9					8.01	7.23	
28	13.0	4.6	.12	.12	15.5			.02	.01	7.88	7.15	
29	12.3	5.5	.14	.14	14.1					8.10	7.40	
30	11.8	6.3	.14	.12	9.2					7.91	7.36	
31	10.0	6.3	.16	.15	9.5					7.99	7.42	

TABLE 2.1: PARTICULATE REMOVAL PROFILE FEBRUARY 1985

MOE WPOS PROTOCOL

DATE	TURBIDITY (FTU)				COAGULANT	COAG. AID	FILTER AID	METAL RES. Al (mg/L)		pH		TEMP. (°C)
	Raw	Set.	Filter	Treat.	mg/L	mg/L	mg/L	Raw	Treat.	Raw	Treat.	Raw
1	8.6	5.5	.15	.15	9.0					8.05	7.38	3
2	8.1	5.5	.17	.17	9.2					7.95	7.44	3
3	6.7	4.6	.21	.21	8.2					8.07	7.54	3
4	8.0	5.3	.24	.23	9.0			.01	.02	7.92	7.39	3
5	7.4	5.0	.17	.18	9.2					7.96	7.32	4
6	5.9	4.3	.18	.19	8.3					7.96	7.37	3
7	5.9	4.5	.16	.17	7.7					8.02	7.38	3
8	6.2	4.4	.20	.20	8.2					8.02	7.48	4
9	6.2	4.7	.21	.22	8.6					8.09	7.52	5
10	5.3	4.3	.21	.21	8.6					7.98	7.46	5
11	5.0	4.4	.19	.18	8.5					8.09	7.52	3
12	4.6	3.5	.16	.17	8.5			.03	.02	8.06	7.50	3
13	5.3	3.9	.16	.16	7.9					8.05	7.49	4
14	5.2	4.7	.19	.29	7.8					8.11	7.58	3
15	5.8	4.5	.22	.21	8.1					7.90	7.17	3

DATE	TURBIDITY (FTU)				COAGULANT ALUM mg/L	COAG. AID mg/L	FILTER AID mg/L	METAL RES. Al (mg/L)		pH		TEMP. (oC)
	Raw	Set.	Filter	Treat.				Raw	Treat.	Raw	Treat.	Raw
16	4.5	3.9	.21	.21	7.3					8.21	7.45	3
17	3.8	3.1	.16	.16	8.0					7.96	7.36	4
18	4.0	3.8	.15	.16	7.3			.01	.02	8.10	7.36	3
19	4.6	3.7	.19	.18	7.4					8.02	7.38	4
20	4.9	4.2	.18	.18	8.2			.01	.01	8.15	7.45	6
21	4.4	3.7	.20	.20	8.0					8.16	7.44	4
22	4.1	3.7	.19	.19	7.7					8.12	7.42	3
23	5.4	4.1	.21	.20	7.9					7.84	8.18	4
24	4.0	3.3	.19	.19	7.9					8.20	7.49	4
25	4.8	3.7	.17	.17	7.6			.03	.01	8.25	7.55	3
26	5.5	4.4	.20	.20	8.5					8.39	7.69	4
27	5.5	4.7	.21	.22	8.8					8.15	7.44	3
28	28.0	9.2	.20	.20	15.1					7.96	7.40	3
29												
30												
31												

TABLE 2.1: PARTICULATE REMOVAL PROFILE MARCH 1985 .

MOE WPOS PROTOCOL

DATE	TURBIDITY (FTU)				COAGULANT ALUM	COAG. AID	FILTER AID	METAL RES. Al (mg/L)		pH		TEMP. (°C)
	Raw	Set.	Filter	Treat.	mg/L	mg/L	mg/L	Raw	Treat.	Raw	Treat.	Raw
1	25.2	7.9	.15	.18	17.6					8.08	7.32	3
2	16.7	5.8	.15	.16	16.5					8.02	7.39	4
3	9.2	4.4	.12	.14	13.0					8.05	7.40	3
4	11.6	5.9	.21	.18	10.9			.01	.01	8.04	7.49	5
5	14.3	6.9	.15	.20	12.6					8.12	7.32	4
6	17.2	8.2	.18	.18	13.0					8.09	7.39	6
7	21.0	8.8	.21	.24	15.1					8.09	7.36	3
8	16.2	5.1	.15	.15	18.6					8.05	7.31	3
9	14.0	4.6	.14	.14	17.4					8.08	7.45	4
10	12.5	4.9	.17	.17	16.8					8.14	7.38	5
11	13.5	5.8	.17	.17	16.8			.01	.01	8.00	7.25	4
12	11.8	4.8	.14	.14	16.7					8.01	7.31	4
13	21.3	6.5	.16	.16	19.1					7.97	7.26	4
14	31.5	9.7	.19	.20	21.3					7.96	7.44	5
15	42.0	8.2	.17	.20	22.9					7.94	7.29	4

TABLE 2.1 (cont'd.) MARCH 1985

DATE	TURBIDITY (FTU)				COAGULANT ALUM	COAG. AID	FILTER AID	METAL RES. Al (mg/L)		pH		TEMP. (oC)
	Raw	Set.	Filter	Treat.	mg/L	mg/L	mg/L	Raw	Treat.	Raw	Treat.	Raw
16	40.8	9.0	.16	.18	24.6					8.05	7.32	5
17	92.5	11.3	.17	.18	31.2					7.99	7.24	5
18	85.3	10.6	.15	.17	30.8			.03	.01	8.06	7.54	8
19	159.0	12.0	.21	.19	39.6					7.76	7.06	4
20	156.5	12.8	.12	.15	42.1					8.05	7.16	5
21	33.0	7.8	.12	.12	22.1					8.09	7.20	4
22	69.0	11.6	.21	.26	27.8					7.96	7.22	4
23	83.7	13.5	.13	.16	31.5					8.00	7.33	4
24	52.3	9.4	.19	.15	25.6					7.98	7.25	4
25	56.7	8.4	.41	.40	27.1			.01	.02	8.13	7.29	5
26	58.3	11.3	.62	.69	23.7					8.04	7.36	4
27	103.8	11.7	.14	.20	25.6					8.01	7.33	4
28	224.0	16.0	.27	.28	47.5					7.97	7.26	6
29	123.0	12.9	.36	.37	38.8					8.04	7.28	6
30	78.8	11.0	.22	.23	34.5					8.01	7.30	6
31	60.3	7.2	.18	.26	31.8					8.05	7.32	6

TABLE 2.1: PARTICULATE REMOVAL PROFILE APRIL 1985

MOE WPOS PROTOCOL

DATE	TURBIDITY (FTU)				COAGULANT ALUM	COAG. AID	FILTER AID	METAL RES. Al (mg/L)		pH		TEMP. (°C)
	Raw	Set.	Filter	Treat.	mg/L	mg/L	mg/L	Raw	Treat.	Raw	Treat.	Raw
1	424.0	14.0	.21	.20	68.6					8.01	7.30	6
2	263.0	12.0	.12	.12	61.7			.08	0	8.03	7.17	5
3	206.0	11.8	.17	.18	52.8					7.94	7.28	7
4	125.0	9.6	.28	.28	42.1					8.12	7.44	5
5	127.0	10.2	.12	.17	44.5					8.03	7.23	8
6	215.0	11.8	.12	.12	52.8					8.03	7.21	7
7	195.8	10.1	.14	.14	51.5					8.00	7.24	7
8	97.3	8.9	.19	.17	39.2			.01	.02	8.16	7.34	6
9	83.7	9.8	.10	.13	37.3					8.09	7.34	8
10	132.0	10.3	.12	.12	36.3					8.13	7.52	6
11	139.0	10.8	.15	.15	37.1					8.09	7.35	7
12	69.7	9.9	.17	.24	28.7					8.10	7.36	7
13	47.8	8.2	.12	.12	25.8					8.06	7.32	7
14	65.0	8.0	.11	.11	28.9					8.05	7.43	8
15	45.2	8.1	.18	.17	25.5			.03	.01	8.14	7.38	8

TABLE 2.1 (cont'd.) APRIL 1985

DATE	TURBIDITY (FTU)				COAGULANT ALUM	COAG. AID	FILTER AID	METAL RES. Al (mg/L)		pH		TEMP. (oC)
	Raw	Set.	Filter	Treat.	mg/L	mg/L	mg/L	Raw	Treat.	Raw	Treat.	Raw
16	30.2	7.9	.16	.18	22.3					8.01	7.37	9
17	24.2	7.4	.11	.14	16.8					7.95	7.41	8
18	35.7	8.7	.14	.14	17.8					7.46	7.74	9
19	123.3	10.7	.14	.14	29.1					8.42	7.58	9
20	45.8	9.8	.14	.15	17.8					8.41	7.54	9
21	27.7	7.7	.19	.16	13.1					8.29	7.40	9
22	24.3	8.4	.21	.21	12.6			.02	.01	8.24	7.48	10
23	23.7	9.0	.14	.17	12.8					8.10	7.47	11
24	20.5	8.1	.15	.15	11.9					8.26	7.68	9
25	19.8	8.0	.19	.19	11.3					8.06	7.52	9
26	17.0	7.0	.18	.18	11.6					8.10	7.41	8
27	17.8	7.0	.16	.17	11.5					8.01	7.27	9
28	13.7	5.0	.16	.17	10.8					8.00	7.27	9
29	14.5	6.2	.16	.17	9.6			.02	.01	8.06	7.25	9
30	14.8	5.4	.13	.14	11.1					8.03	7.38	9
31												

TABLE 2.1: PARTICULATE REMOVAL PROFILE MAY 1985

MOE WPOS PROTOCOL

DATE	TURBIDITY (FTU)				COAGULANT ALUM	COAG. AID	FILTER AID	METAL RES. Al (mg/L)		pH		TEMP. (°C)
	Raw	Set.	Filter	Treat.	mg/L	mg/L	mg/L	Raw	Treat.	Raw	Treat.	Raw
1	12.7	4.8	.12	.13	9.8					8.00	7.34	9
2	14.3	4.3	.13	.14	10.7					8.44	7.39	9
3	15.3	4.7	.12	.14	11.9					8.09	7.41	10
4	18.7	6.0	.15	.15	12.0					8.08	7.43	10
5	19.0	5.1	.15	.15	12.6					8.11	7.45	11
6	19.2	4.4	.12	.13	12.4			.04	.01	8.37	7.58	11
7	24.3	4.1	.10	.10	14.6					8.29	7.59	11
8	17.2	4.9	.12	.13	11.2					8.30	7.59	11
9	14.5	4.7	.17	.17	9.6					8.18	7.56	11
10	15.7	4.9	.15	.15	9.8					8.19	7.46	10
11	10.4	3.7	.16	.14	9.6					8.34	7.50	10
12	9.9	3.3	.11	.12	11.4					8.28	7.36	11
13	8.6	2.9	.12	.12	9.8			.02	.01	8.26	7.30	11
14	12.5	3.3	.15	.14	10.4					8.02	7.29	11
15	13.8	4.0	.16	.17	10.3					8.20	7.35	11

TABLE 2.1 (cont'd.) MAY 1985

DATE	TURBIDITY (FTU)				COAGULANT ALUM	COAG. AID	FILTER AID	METAL RES. Al (mg/L)		pH		TEMP. (oC)
	Raw	Set.	Filter	Treat.	mg/L	mg/L	mg/L	Raw	Treat.	Raw	Treat.	Raw
16	9.6	3.3	.14	.15	9.8					8.16	7.46	15
17	11.9	3.7	.13	.14	10.2					8.10	7.48	14
18	10.6	3.9	.16	.16	9.6					8.07	7.47	10
19	6.5	2.6	.12	.13	8.4					8.11	7.50	11
20	22.7	3.6	.14	.14	12.8			.02	.01	8.17	7.56	12
21	24.7	3.9	.13	.14	12.8			.01	.01	8.03	7.47	12
22	21.2	4.6	.15	.17	11.7					8.04	7.47	13
23	15.0	3.6	.13	.14	11.5					8.12	7.48	12
24	18.0	3.6	.12	.13	12.3					8.03	7.46	13
25	15.0	3.8	.12	.12	10.6					8.10	7.47	13
26	14.5	3.4	.12	.13	10.2					7.98	7.47	13
27	15.5	4.1	.16	.16	12.3					8.11	7.34	14
28	15.8	4.1	.16	.16	11.2			.02	.02	8.00	7.31	14
29	25.3	4.4	.16	.16	14.0					8.04	7.39	14
30	16.2	3.6	.12	.14	12.1					8.21	7.48	15
31	92.8	3.8	.11	.12	20.5					8.22	7.47	15

TABLE 2.1: PARTICULATE REMOVAL PROFILE JUNE 1985 .

MOE WPOS PROTOCOL

DATE	TURBIDITY (FTU)				COAGULANT	COAG. AID	FILTER AID	METAL RES. Al (mg/L)		pH		TEMP. (°C)
	Raw	Set.	Filter	Treat.	mg/L	mg/L	mg/L	Raw	Treat.	Raw	Treat.	Raw
1	72.5	4.8	.12	.12	23.1					8.10	7.25	
2	16.3	3.9	.12	.12	13.3					7.98	7.36	
3	11.8	3.4	.11	.13	11.7			.02	.01	8.10	7.49	
4	15.3	4.2	.14	.15	12.5					7.70	7.30	
5	15.2	3.3	.10	.13	11.6					8.12	7.46	
6	13.2	3.4	.11	.12	11.8					7.94	7.32	
7	11.4	3.1	.14	.15	10.7					7.87	7.28	
8	12.9	3.4	.16	.16	11.9					8.10	7.35	
9	43.8	5.0	.15	.15	14.1					8.19	7.45	
10	29.7	6.6	.13	.13	13.5			.03	.02	7.79	7.26	
11	17.2	4.6	.13	.13	11.5					7.75	7.28	
12	12.3	3.3	.12	.13	10.7					7.70	7.29	
13	11.2	3.7	.13	.12	10.2					7.80	7.42	
14	15.2	4.0	.13	.14	12.4					7.78	7.37	
15	15.0	3.8	.15	.16	12.5					7.97	7.46	

TABLE 2.1 (cont'd.) JUNE 1985

DATE	TURBIDITY (FTU)				COAGULANT ALUM	COAG. AID	FILTER AID	METAL RES. Al (mg/L)		pH		TEMP. (oC)
	Raw	Set.	Filter	Treat.	mg/L	mg/L	mg/L	Raw	Treat.	Raw	Treat.	Raw
16	28.3	4.8	.13	.17	18.5					8.03	7.38	13
17	16.8	3.6	.12	.14	12.6			.02	0	7.91	7.16	14
18	24.5	3.9	.14	.15	13.7					7.96	7.18	14
19	33.0	4.8	.13	.14	17.3					7.86	7.16	14
20	15.0	3.9	.15	.15	14.3					7.68	7.31	14
21	11.8	3.6	.15	.15	11.6					7.62	7.20	13
22	23.0	4.9	.17	.18	12.0					7.96	7.41	16
23	51.7	5.5	.14	.17	19.5					7.86	7.38	17
24	33.8	5.8	.15	.16	19.4			.02	0	7.81	7.31	13
25	14.0	4.2	.13	.15	12.5					7.75	7.32	13
26	10.4	2.9	.12	.13	11.9					7.77	7.25	14
27	17.7	3.9	.14	.15	12.5					7.77	7.28	14
28	16.7	4.0	.15	.18	12.6					7.80	7.23	16
29	15.5	4.2	.13	.14	11.1					7.89	7.26	14
30	15.3	3.0	.14	.15	11.5					7.92	7.29	17
31												

TABLE 2.1: PARTICULATE REMOVAL PROFILE JULY 1985 .

MOE WPOS PROTOCOL

DATE	TURBIDITY (FTU)				COAGULANT ALUM	COAG. AID	FILTER AID	METAL RES. Al (mg/L)		pH		TEMP. (°C)
	Raw	Set.	Filter	Treat.	mg/L	mg/L	mg/L	Raw	Treat.	Raw	Treat.	Raw
1	16.3	3.2	.15	.15	11.1					7.92	7.30	17
2	14.2	3.1	.14	.15	9.1			.01	.02	8.30	7.52	18
3	12.5	3.3	.13	.13	11.5					8.15	7.51	19
4	19.0	4.4	.14	.14	15.3					7.75	7.33	18
5	23.0	4.0	.14	.14	14.2					7.73	7.29	17
6	24.7	3.5	.13	.13	15.9					8.03	7.25	20
7	15.2	4.1	.13	.13	12.1					7.58	7.20	15
8	17.5	4.3	.15	.15	11.9			0	.02	7.60	7.30	15
9	22.5	4.8	.14	.15	16.4					7.50	7.30	16
10	14.7	4.1	.15	.14	12.5					7.58	7.23	16
11	11.5	4.6	.12	.12	10.1					7.92	7.30	15
12	13.2	3.3	.12	.13	10.0					7.90	7.28	16
13	17.8	4.1	.15	.16	11.7					7.71	7.16	18
14	40.0	4.4	.14	.17	17.4					7.59	7.19	18
15	38.8	5.0	.11	.13	16.6			.04	0	7.34	6.83	18

TABLE 2.1 (cont'd.) JULY 1985

DATE	TURBIDITY (FTU)				COAGULANT ALUM	COAG. AID	FILTER AID	METAL RES. Al (mg/L)		pH		TEMP. (oC)
	Raw	Set.	Filter	Treat.	mg/L	mg/L	mg/L	Raw	Treat.	Raw	Treat.	Raw
16	33.2	5.5	.13	.13	15.9					7.68	7.16	18
17	23.8	5.5	.14	.14	12.7					7.60	7.08	18
18	18.8	3.6	.12	.12	12.7					7.60	7.10	19
19	26.2	4.0	.12	.12	14.1					7.80	7.27	19
20	15.5	3.9	.10	.11	13.2					7.57	7.19	16
21	12.7	4.0	.15	.16	9.9					7.57	7.15	17
22	13.0	4.7	.17	.19	9.4			.01	.02	7.59	7.13	15
23	11.3	4.2	.15	.15	9.4					7.44	7.11	14
24	8.6	3.4	.14	.14	9.7					7.59	7.19	15
25	14.2	3.9	.15	.15	10.7					7.83	7.18	15
26	18.3	4.8	.16	.17	13.1					7.61	7.20	17
27	17.0	4.2	.12	.13	11.6					7.65	7.26	18
28	19.0	4.7	.16	.16	11.6					7.85	7.19	19
29	17.3	4.8	.15	.15	11.6					7.70	7.21	18
30	18.2	4.5	.15	.15	12.0			0	0	7.78	7.17	19
31	21.2	3.9	.15	.15	12.6					8.02	7.39	21

TABLE 2.1: PARTICULATE REMOVAL PROFILE AUGUST 1985.

MOE WPOS PROTOCOL

DATE	TURBIDITY (FTU)				COAGULANT ALUM	COAG. AID	FILTER AID	METAL RES. Al (mg/L)		pH		TEMP. (°C)
	Raw	Set.	Filter	Treat.	mg/L	mg/L	mg/L	Raw	Treat.	Raw	Treat.	Raw
1	19.8	3.7	.17	.17	11.3					7.68	7.37	21
2	20.3	4.8	.16	.17	13.8					7.76	7.19	20
3	16.8	4.1	.17	.17	12.4					8.13	7.39	21
4	17.8	4.0	.14	.16	13.1					7.80	7.27	21
5	20.5	3.7	.15	.15	12.8			.03	.01	8.10	7.24	22
6	40.2	5.3	.18	.18	16.7					8.45	7.52	23
7	48.7	5.2	.17	.17	18.3					8.25	7.40	23
8	22.0	4.5	.17	.18	13.2					7.94	7.39	22
9	24.5	5.2	.17	.17	12.7					7.94	7.32	22
10	32.0	5.5	.16	.16	14.7					8.06	7.36	22
11	22.0	4.7	.14	.14	12.2					7.94	7.27	22
12	15.0	4.4	.13	.13	11.8			.02	.01	7.73	7.20	21
13	22.7	3.8	.13	.14	14.4					7.53	7.04	22
14	23.2	3.7	.13	.13	14.4					7.90	7.23	22
15	21.0	4.1	.14	.15	12.6					7.76	7.25	22

TABLE 2.1 (cont'd.) AUGUST 1985

DATE	TURBIDITY (FTU)				COAGULANT ALUM	COAG. AID	FILTER AID	METAL RES. Al (mg/L)		pH		TEMP. (oC)
	Raw	Set.	Filter	Treat.	mg/L	mg/L	mg/L	Raw	Treat.	Raw	Treat.	Raw
16	17.0	3.2	.11	.12	11.6					7.84	7.27	22
17	14.5	2.7	.13	.14	11.1					7.83	7.26	22
18	22.8	3.1	.13	.13	14.8					7.84	7.30	22
19	23.8	3.1	.14	.14	14.7			.03	.03	8.20	7.43	23
20	13.0	4.1	.16	.16	12.8					7.56	7.24	21
21	3.3	3.2	.14	.16	9.5					7.36	6.98	19
22	3.6	2.7	.19	.18	8.1					7.41	7.03	19
23	2.7	1.9	.13	.14	7.3					7.45	7.14	19
24	13.4	2.5	.16	.15	9.6					7.94	7.13	21
25	39.9	3.8	.18	.20	15.9					8.25	7.34	22
26	25.7	4.2	.18	.19	12.1			.02	.02	8.25	7.41	22
27	17.8	4.2	.20	.22	11.4					8.28	7.45	22
28	13.5	3.0	.13	.14	11.4					8.25	7.38	22
29	20.2	4.1	.14	.15	11.5					8.20	7.47	22
30	24.3	4.6	.18	.19	14.2					8.16	7.43	22
31	14.0	3.0	.16	.16	9.8					8.09	7.43	22

TABLE 2.1: PARTICULATE REMOVAL PROFILE SEPTEMBER 1985

MOE WPOS PROTOCOL

DATE	TURBIDITY (FTU)				COAGULANT ALUM	COAG. AID	FILTER AID	METAL RES. Al (mg/L)		pH		TEMP. (oC)
	Raw	Set.	Filter	Treat.	mg/L	mg/L	mg/L	Raw	Treat.	Raw	Treat.	Raw
1	20.5	9.2	.16	.17	11.0					8.10	7.38	22
2	15.7	3.2	.16	.18	11.7			0	.03	7.98	7.27	22
3	14.0	2.8	.15	.16	10.8					8.02	7.33	22
4	16.5	3.3	.15	.16	11.4					7.84	7.26	22
5	10.8	2.5	.16	.15	10.8					7.55	7.18	21
6	23.3	3.7	.15	.16	14.1					7.68	7.22	22
7	12.6	3.0	.13	.15	12.2					7.52	7.13	22
8	12.7	3.3	.13	.14	10.3					7.60	7.23	22
9	14.3	4.0	.12	.13	9.6			0	.02	7.76	7.25	21
10	10.3	3.3	.12	.13	9.3					7.72	7.18	21
11	13.7	2.9	.14	.14	9.0					7.78	7.19	21
12	11.5	4.0	.17	.19	9.3					7.88	7.35	21
13	10.2	4.4	.19	.19	9.0					7.84	7.29	21
14	9.1	3.1	.18	.17	9.0					7.96	7.35	20
15	13.8	3.8	.17	.18	9.3					7.88	7.34	20

TABLE 2.1 (cont'd.) SEPTEMBER 1985

DATE	TURBIDITY (FTU)				COAGULANT ALUM	COAG. AID	FILTER AID	METAL RES. Al (mg/L)		pH		TEMP. (oC)
	Raw	Set.	Filter	Treat.	mg/L	mg/L	mg/L	Raw	Treat.	Raw	Treat.	Raw
16	11.2	3.3	.16	.16	9.3			.02	0	7.98	7.41	20
17	7.7	3.0	.16	.15	8.9					8.16	7.37	20
18	10.9	4.1	.18	.18	8.5					7.91	7.38	20
19	12.7	3.8	.18	.18	9.6					7.79	7.31	20
20	15.0	4.2	.18	.18	9.7					7.72	7.25	20
21	10.0	3.2	.15	.16	9.4					7.89	7.27	20
22	17.8	3.7	.17	.17	11.1					7.93	7.39	21
23	31.8	3.7	.15	.16	16.4			0	0	8.32	7.37	21
24	35.2	4.4	.18	.19	16.3					8.42	7.59	21
25	39.2	5.3	.17	.18	16.9					8.28	7.47	21
26	120.2	7.4	.15	.18	25.6					8.19	7.38	21
27	109.0	7.3	.14	.14	21.5					8.18	7.41	20
28	48.8	6.0	.14	.14	15.5					8.19	7.42	20
29	31.3	4.5	.13	.14	14.4					8.14	7.34	20
30	32.2	4.1	.13	.14	15.8			.03	.02	8.06	7.38	20
31												

TABLE 2.1: PARTICULATE REMOVAL PROFILE OCTOBER 1985

MOE WPOS PROTOCOL

DATE	TURBIDITY (FTU)				COAGULANT ALUM	COAG. AID	FILTER AID	METAL RES. Al (mg/L)		pH		TEMP. (°C)
	Raw	Set.	Filter	Treat.	mg/L	mg/L	mg/L	Raw	Treat.	Raw	Treat.	Raw
1	37.0	5.8	.14	.16	14.7					8.14	7.40	20
2	29.7	5.8	.17	.17	12.6					8.26	7.46	19
3	23.5	5.8	.14	.15	11.7					8.17	7.38	19
4	22.5	4.2	.15	.16	12.2					8.14	7.32	18
5	210.8	4.9	.19	.18	32.3					8.21	7.38	18
6	144.0	6.9	.14	.14	22.7			.05	.04	8.19	7.38	18
7	63.2	6.3	.14	.14	18.8					8.17	7.38	18
8	104.0	6.4	.14	.15	26.0					8.07	7.24	18
9	111.7	5.4	.14	.14	29.3					8.15	7.40	17
10	58.8	4.4	.12	.13	23.4					8.17	7.33	17
11	29.8	4.1	.12	.11	13.0					8.07	7.30	16
12	19.2	3.5	.13	.13	10.2					8.10	7.44	17
13	103.7	5.4	.14	.16	25.1					7.98	7.42	17
14	43.3	4.1	.13	.15	15.5			.02	.03	8.00	7.43	17
15	24.2	4.0	.16	.14	12.7					8.10	7.48	17

TABLE 2.1 (cont'd.) OCTOBER 1985

DATE	TURBIDITY (FTU)				COAGULANT ALUM	COAG. AID	FILTER AID	METAL RES. Al (mg/L)		pH		TEMP. (oC)
	Raw	Set.	Filter	Treat.	mg/L	mg/L	mg/L	Raw	Treat.	Raw	Treat.	Raw
16	32.3	5.3	.17	.16	13.0					8.20	7.35	17
17	26.3	5.4	.18	.18	12.4					8.12	7.47	16
18	58.8	4.8	.13	.16	17.2					8.17	7.46	17
19	42.2	5.3	.12	.13	16.9					8.20	7.44	17
20	24.0	4.7	.12	.14	12.5					8.18	7.46	17
21	47.2	5.1	.16	.15	17.1			.02	.03	8.14	7.43	15
22	76.0	5.1	.12	.13	19.4					8.15	7.43	15
23	41.7	4.2	.11	.11	15.3					8.23	7.47	16
24	82.0	4.9	.11	.12	22.3					8.14	7.52	16
25	43.7	4.7	.12	.13	17.8					8.06	7.50	15
26	30.0	4.9	.13	.15	14.6					8.02	7.52	16
27	35.0	5.0	.11	.11	14.8					8.05	7.44	16
28	23.8	4.4	.12	.12	12.1			.01	0	8.04	7.46	16
29	27.7	4.9	.12	.13	13.5					8.02	7.49	15
30	26.0	5.6	.15	.16	13.3					8.10	7.43	15
31	24.5	5.2	.13	.13	12.4					8.09	7.37	15

TABLE 2.1: PARTICULATE REMOVAL PROFILE NOVEMBER 1985

MOE WPOS PROTOCOL

DATE	TURBIDITY (FTU)				COAGULANT ALUM	COAG. AID	FILTER AID	METAL RES. Al (mg/L)		pH		TEMP. (°C)
	Raw	Set.	Filter	Treat.	mg/L	mg/L	mg/L	Raw	Treat.	Raw	Treat.	Raw
1	31.3	5.7	.17	.16	13.0					8.05	7.55	14
2	56.4	6.0	.15	.15	14.9					8.15	7.55	14
3	78.7	5.0	.13	.12	19.4					8.17	7.60	15
4	144.4	6.6	.12	.12	27.8			.06	.03	8.10	7.54	14
5	101.0	6.4	.11	.12	24.3					8.03	7.56	14
6	53.3	6.6	.12	.14	19.2					8.15	7.50	14
7	101.5	8.5	.11	.13	23.8					8.00	7.55	14
8	110.5	7.5	.11	.12	23.1					8.18	7.47	14
9	79.3	6.3	.14	.14	17.2					8.11	7.43	13
10	120.8	7.8	.13	.13	21.3					8.10	7.41	14
11	77.0	7.5	.14	.15	19.4			.04	.04	8.12	7.69	14
12	152.0	10.9	.10	.13	28.0					7.78	7.02	13
13	68.5	9.4	.10	.12	23.0					8.37	7.28	13
14	52.8	9.0	.14	.14	18.8					8.25	7.46	13
15	34.5	7.3	.14	.14	15.3					8.12	7.41	13

TABLE 2.1 (cont'd.) NOVEMBER 1985

DATE	TURBIDITY (FTU)				COAGULANT ALUM	COAG. AID	FILTER AID	METAL RES. Al (mg/L)		pH		TEMP. (oC)
	Raw	Set.	Filter	Treat.	mg/L	mg/L	mg/L	Raw	Treat.	Raw	Treat.	Raw
16	65.3	8.6	.12	.12	18.0					8.24	7.47	12
17	138.0	7.6	.12	.12	22.8					8.15	7.50	12
18	75.0	9.3	.11	.12	19.7			.03	.01	8.21	7.49	11
19	114.5	8.0	.10	.11	24.8					8.14	7.49	13
20	128.0	8.1	.08	.09	25.3					8.12	7.42	13
21	115.5	9.6	.11	.11	20.7					8.35	7.62	11
22	143.6	9.9	.19	.19	21.2					8.30	7.65	12
23	144.0	10.3	.13	.15	23.8					8.24	7.62	11
24	78.2	9.0	.08	.10	19.4					8.29	7.61	12
25	59.0	7.7	.08	.10	17.7			.03	.04	8.22	7.52	12
26	56.8	8.4	.12	.12	16.5					8.14	7.54	10
27	67.8	10.0	.16	.21	17.9					8.18	7.50	10
28	70.8	8.8	.10	.10	18.1					8.18	7.48	9
29	162.5	11.6	.10	.11	26.2					8.19	7.62	9
30	63.3	9.8	.15	.19	17.7					8.26	7.65	9
31												

TABLE 2.1: PARTICULATE REMOVAL PROFILE DECEMBER 1985

MOE WPOS PROTOCOL

DATE	TURBIDITY (FTU) Raw	Set.	Filter	Treat.	COAGULANT ALUM mg/L	COAG. AID mg/L	FILTER AID mg/L	METAL RES. Al (mg/L) Raw	Treat.	pH Raw	Treat.	TEMP. (°C) Raw
1	50.0	8.6	.10	.15	17.5					8.19	7.59	9
2	219.2	9.8	.10	.11	34.3			.04	.02	8.16	7.70	10
3	199.2	9.4	.13	.11	30.9					8.02	7.54	9
4	80.2	10.0	.17	.18	21.5					8.21	7.70	9
5	67.2	9.8	.11	.11	18.7					8.19	7.58	10
6	86.7	9.6	.12	.14	23.8					8.27	7.54	9
7	72.2	12.0	.15	.15	18.5					8.07	7.70	9
8	101.7	8.7	.12	.15	22.2					8.23	7.59	7
9	48.3	7.4	.10	.10	16.2			.03	0	8.25	7.54	7
10	32.3	8.3	.11	.11	11.9					8.24	7.61	8
11	63.7	9.6	.13	.13	18.3					8.30	7.66	8
12	41.2	10.0	.13	.13	15.5					8.11	7.62	9
13	39.8	8.8	.09	.10	17.0					8.08	7.52	7
14	33.7	7.1	.10	.11	15.7					8.08	7.54	7
15	128.5	7.4	.13	.14	26.7					8.10	7.50	7

TABLE 2.1 (cont'd.) DECEMBER 1985

DATE	TURBIDITY (FTU)				COAGULANT ALUM mg/L	COAG. AID mg/L	FILTER AID mg/L	METAL RES. Al (mg/L)		pH		TEMP. (oC)
	Raw	Set.	Filter	Treat.				Raw	Treat.	Raw	Treat.	Raw
16	176.7	9.1	.13	.13	32.2			.02	0	8.16	7.39	5
17	120.2	9.0	.12	.11	23.4					8.12	7.50	6
18	71.8	7.5	.11	.11	21.4					8.15	7.65	5
19	80.7	8.3	.18	.19	20.0					8.22	7.64	6
20	74.5	10.8	.12	.13	19.2					8.19	7.58	4
21	50.0	9.4	.09	.10	16.6					8.12	7.56	5
22	79.2	7.9	.10	.11	21.7					8.14	7.66	4
23	145.8	9.5	.13	.12	28.2			.01	.01	8.33	7.63	5
24	101.3	8.0	.08	.10	23.5					8.11	7.62	4
25	58.5	8.3	.09	.10	19.4					8.24	7.62	4
26	60.9	7.9	.09	.09	19.7					8.10	7.48	3
27	110.8	7.2	.10	.10	25.7					8.06	7.47	3
28	66.3	6.7	.12	.11	18.9					8.19	7.63	4
29	40.0	6.4	.13	.13	14.5					8.10	7.52	4
30	15.8	6.6	.11	.12	8.8					8.06	7.76	5
31	22.7	6.3	.12	.13	10.7					8.13	7.67	5

TABLE 2.1: PARTICULATE REMOVAL PROFILE JANUARY 1984.

MOE WPOS PROTOCOL

DATE	TURBIDITY (FTU)				COAGULANT ALUM	COAG. AID	FILTER AID	METAL RES. Al (mg/L)		pH		TEMP. (°C)
	Raw	Set.	Filter	Treat.	mg/L	mg/L	mg/L	Raw	Treat.	Raw	Treat.	Raw
1	11.5	4.4	.12	.12	10.1					8.11	7.39	3
2	14.7	5.4	.11	.11	10.8			.06	.02	8.15	7.48	3
3	15.3	5.7	.11	.11	12.7					8.10	7.45	3
4	13.5	5.3	.10	.10	11.9					8.02	7.44	3
5	15.3	7.0	.13	.13	10.2					8.04	7.51	5
6	13.0	7.4	.16	.15	9.6					8.11	7.54	5
7	11.0	5.5	.12	.11	11.0					8.13	7.55	4
8	10.7	5.0	.12	.11	10.5					8.08	7.50	4
9	11.8	5.3	.15	.15	10.8			.05	.02	8.12	7.58	4
10	11.3	6.0	.14	.15	11.5					8.05	7.49	4
11	9.7	5.7	.10	.10	10.0					8.04	7.43	3
12	8.2	5.5	.11	.11	10.7					8.10	7.42	4
13	10.9	5.2	.11	.12	10.7					8.01	7.39	3
14	7.8	4.5	.11	.11	8.6					8.06	7.41	3
15	6.0	4.0	.11	.11	8.2					7.98	7.40	3

TABLE 2.1 (cont'd.) JANUARY 1984

DATE	TURBIDITY (FTU)				COAGULANT ALUM	COAG. AID	FILTER AID	METAL RES. Al (mg/L)		pH		TEMP. (oC)
	Raw	Set.	Filter	Treat.	mg/L	mg/L	mg/L	Raw	Treat.	Raw	Treat.	Raw
16	8.2	4.9	.12	.12	9.0			.03	.04	8.07	7.48	4
17	6.8	5.1	.14	.14	8.8					8.09	7.55	3
18	7.3	5.2	.13	.13	9.1					8.18	7.50	3
19	7.4	5.1	.14	.13	8.1					8.06	7.58	3
20	5.6	4.7	.12	.12	7.7					8.10	7.52	3
21	4.9	4.2	.10	.10	7.4					8.04	7.52	3
22	4.8	3.9	.10	.10	7.5					8.08	7.44	3
23	4.6	4.4	.11	.12	7.6			.03	.07	8.04	7.56	3
24	4.2	3.5	.10	.10	7.5					7.98	7.53	3
25	5.3	3.9	.12	.12	7.5					8.03	7.54	2
26	5.8	4.8	.13	.13	7.7					8.03	7.51	3
27	4.9	4.0	.12	.12	7.4					8.08	7.56	3
28	5.0	4.2	.12	.12	7.3					8.03	7.53	3
29	5.0	4.0	.14	.14	7.5					8.00	7.51	3
30	3.9	3.7	.12	.12	6.6			.02	.05	8.00	7.49	3
31	4.0	3.7	.10	.10	7.4					8.07	7.55	3

TABLE 2.1: PARTICULATE REMOVAL PROFILE FEBRUARY 1984

MOE WPOS PROTOCOL

DATE	TURBIDITY (FTU)				COAGULANT ALUM	COAG. AID	FILTER AID	METAL RES. Al (mg/L)		pH		TEMP. (°C)
	Raw	Set.	Filter	Treat.	mg/L	mg/L	mg/L	Raw	Treat.	Raw	Treat.	Raw
1	4.1	3.9	.12	.12	7.4					8.10	7.56	3
2	4.0	4.4	.15	.15	7.5					8.15	7.60	4
3	3.9	3.9	.16	.16	7.4					8.00	7.58	4
4	3.9	3.8	.15	.13	7.4					7.89	7.42	4
5	4.4	3.8	.17	.17	7.2					8.04	7.30	5
6	4.3	4.2	.13	.14	7.3			.02	.05	7.90	7.35	4
7	3.5	3.9	.13	.13	7.4					8.02	7.37	5
8	4.2	4.2	.13	.13	7.5					8.14	7.32	4
9	3.8	3.7	.12	.13	7.4					8.08	7.28	4
10	4.3	3.8	.13	.13	7.5					8.07	7.34	3
11	3.7	3.9	.13	.13	7.0					7.98	7.32	3
12	4.4	3.9	.16	.17	7.4					7.95	7.34	4
13	4.3	3.8	.15	.15	7.4			.01	.02	8.16	7.21	4
14	4.4	3.8	.15	.16	7.4					8.07	7.30	5
15	5.1	4.3	.15	.14	7.7					7.77	7.10	5

TABLE 2.1 (cont'd.) FEBRUARY 1984

DATE	TURBIDITY (FTU)				COAGULANT ALUM	COAG. AID	FILTER AID	METAL RES. Al (mg/L)		pH		TEMP. (oC)
	Raw	Set.	Filter	Treat.	mg/L	mg/L	mg/L	Raw	Treat.	Raw	Treat.	Raw
16	5.5	4.6	.14	.14	7.6					7.98	7.21	5
17	23.0	10.1	.23	.23	15.8					8.03	7.32	5
18	39.7	11.4	.23	.23	20.9					8.02	7.31	5
19	17.7	5.6	.14	.14	16.2					8.06	7.30	5
20	10.2	4.9	.18	.18	13.1			0	0	8.05	7.32	4
21	11.3	6.1	.12	.12	11.4					8.02	7.34	4
22	16.3	7.7	.18	.18	11.8					8.13	7.34	4
23	24.8	9.9	.21	.21	17.3					8.22	7.39	4
24	20.0	6.5	.12	.12	17.4					8.20	7.34	4
25	16.3	6.6	.21	.22	15.6					8.18	7.32	4
26	18.3	6.4	.20	.21	16.6			0	.01	8.20	7.34	4
27	17.2	6.1	.11	.11	17.8					8.21	7.33	4
28	72.4	9.1	.22	.22	22.5					8.21	7.34	3
29	65.3	12.0	.27	.27	28.7					8.04	7.34	3
30												
31												

TABLE 2.1: PARTICULATE REMOVAL PROFILE MARCH 1984

MOE WPOS PROTOCOL

DATE	TURBIDITY (FTU)				COAGULANT ALUM	COAG. AID	FILTER AID	METAL RES. Al (mg/L)		pH		TEMP. (°C)
	Raw	Set.	Filter	Treat.	mg/L	mg/L	mg/L	Raw	Treat.	Raw	Treat.	Raw
1	24.7	6.8	.17	.16	21.0					8.20	7.35	4
2	22.5	6.9	.35	.30	21.3					8.24	7.41	5
3	12.2	4.7	.27	.31	18.2					8.21	7.32	3
4	15.1	6.3	.16	.20	13.0					7.95	7.20	4
5	11.4	6.5	.15	.15	12.9					8.17	7.28	3
6	7.8	5.3	.23	.19	11.9					8.24	7.36	3
7	11.7	5.0	.17	.15	15.0					8.40	7.35	4
8	11.4	5.4	.12	.12	15.8					8.14	7.10	5
9	13.3	5.4	.11	.11	15.6					8.25	7.28	5
10	9.3	4.7	.11	.11	15.0					8.35	7.30	4
11	6.3	3.6	.11	.11	12.6					8.32	7.33	4
12	7.5	5.5	.14	.14	11.4			0	.01	8.24	7.09	4
13	8.7	6.3	.19	.19	11.0					8.35	7.63	4
14	9.0	4.2	.17	.17	14.9					8.46	7.65	4
15	5.8	3.6	.14	.14	14.6					8.43	7.42	4

TABLE 2.1 (cont'd.) MARCH 1984

DATE	TURBIDITY (FTU)				COAGULANT ALUM	COAG. AID	FILTER AID	METAL RES. Al (mg/L)		pH		TEMP. (oC)
	Raw	Set.	Filter	Treat.	mg/L	mg/L	mg/L	Raw	Treat.	Raw	Treat.	Raw
16	4.8	3.7	.13	.13	10.9					8.39	7.41	4
17	4.7	3.2	.11	.11	10.7					8.34	7.47	4
18	14.7	4.1	.14	.14	17.2					8.34	7.36	4
19	9.3	4.1	.13	.13	14.9			.01	.02	8.31	7.39	4
20	23.0	7.9	.17	.17	17.8					8.34	7.47	4
21	22.8	7.4	.17	.17	19.8					8.32	7.36	4
22	84.0	14.0	.23	.18	24.9					8.24	7.34	3
23	86.0	11.4	.25	.23	30.6					8.17	7.29	3
24	17.5	4.9	.20	.23	19.0					8.34	7.32	3
25	5.0	3.6	.18	.19	10.9					8.33	7.37	4
26	6.3	4.4	.15	.14	8.5			.01	.02	8.24	7.43	3
27	15.5	6.6	.18	.18	16.0					8.18	7.27	4
28	18.6	6.1	.12	.16	17.7					7.48	8.05	5
29	48.0	7.7	.14	.14	23.9					8.04	7.30	5
30	80.2	14.3	.15	.16	29.5					8.09	7.30	5
31	30.8	8.7	.28	.29	21.3					8.12	7.48	6

TABLE 2.1: PARTICULATE REMOVAL PROFILE APRIL 1984

MOE WPOS PROTOCOL

DATE	TURBIDITY (FTU)				COAGULANT ALUM	COAG. AID	FILTER AID	METAL RES. Al (mg/L)		pH		TEMP. (°C)
	Raw	Set.	Filter	Treat.	mg/L	mg/L	mg/L	Raw	Treat.	Raw	Treat.	Raw
1	32.3	9.4	.14	.17	20.8					8.20	7.29	7
2	28.3	8.1	.17	.17	20.3			.01	.02	8.12	7.33	7
3	24.5	7.6	.16	.15	20.6					8.06	7.33	6
4	68.7	10.0	.13	.13	26.6					8.22	7.12	6
5	122.0	11.7	.16	.15	28.7					8.21	7.06	6
6	53.3	9.2	.17	.17	24.8					8.04	7.19	6
7	29.2	7.3	.14	.13	20.6					8.15	7.17	6
8	27.2	7.4	.13	.13	21.2					7.95	7.21	6
9	41.7	6.5	.16	.15	18.4			0	0	7.76	6.94	6
10	57.7	9.5	.18	.15	24.3					8.04	7.20	7
11	92.0	9.1	.16	.16	27.3					8.12	7.21	7
12	29.8	6.4	.11	.11	19.9					7.82	7.33	7
13	30.8	5.2	.11	.11	22.2					8.26	7.35	7
14	25.7	6.2	.10	.10	20.4					8.12	7.33	7
15	15.0	4.3	.10	.10	17.9					8.18	7.27	7

TABLE 2.1 (cont'd.) APRIL 1984

DATE	TURBIDITY (FTU)				COAGULANT ALUM	COAG. AID	FILTER AID	METAL RES. Al (mg/L)		pH		TEMP. (oC)
	Raw	Set.	Filter	Treat.	mg/L	mg/L	mg/L	Raw	Treat.	Raw	Treat.	Raw
16	16.0	4.6	.11	.11	14.8					7.97	7.38	10
17	9.8	4.2	.15	.15	13.2					8.06	7.26	8
18	12.4	3.7	.12	.12	14.8					8.03	7.26	9
19	10.0	3.8	.13	.12	12.6					8.09	7.35	9
20	10.5	3.8	.13	.13	11.5					7.98	7.34	9
21	11.0	3.0	.10	.12	13.9					7.95	7.33	9
22	121.0	3.1	.12	.10	18.7					7.99	7.30	9
23	88.5	7.3	.14	.12	23.6					8.12	7.41	8
24	46.0	5.9	.10	.10	18.0					8.18	7.39	8
25	42.0	6.6	.14	.13	19.0					7.88	7.06	8
26	32.2	5.2	.13	.13	17.2					8.05	7.20	9
27	27.8	6.8	.17	.17	16.0					8.03	7.22	8
28	15.0	5.3	.16	.16	12.1					8.09	7.31	9
29	15.5	5.5	.16	.16	11.0					8.05	7.30	8
30	180.0	7.2	.16	.16	27.2					7.96	7.36	9
31												

TABLE 2.1: PARTICULATE REMOVAL PROFILE MAY 1984

MOE WPOS PROTOCOL

DATE	TURBIDITY (FTU)				COAGULANT ALUM	COAG. AID	FILTER AID	METAL RES. Al (mg/L)		pH		TEMP. (°C)
	Raw	Set.	Filter	Treat.	mg/L	mg/L	mg/L	Raw	Treat.	Raw	Treat.	Raw
1	251.0	8.3	.14	.14	40.5			.04	0	7.96	7.24	9
2	73.3	6.1	.11	.11	23.2					7.97	7.11	10
3	56.8	6.3	.16	.15	23.1					7.92	7.07	10
4	30.5	6.4	.16	.14	15.7					8.00	7.16	10
5	27.0	5.7	.16	.15	13.1					7.99	7.22	10
6	25.7	4.7	.13	.12	17.0					8.01	7.22	10
7	24.5	5.3	.13	.14	14.5			.01	.02	8.08	7.18	10
8	21.8	4.9	.15	.18	12.8					8.02	7.30	11
9	33.5	5.3	.12	.13	15.4					8.00	7.26	10
10	33.7	4.9	.13	.13	17.0					7.98	7.22	10
11	50.7	6.4	.14	.14	19.8					7.98	7.28	11
12	33.7	5.4	.13	.13	17.0					8.02	7.30	11
13	23.3	5.1	.13	.13	14.6					7.96	7.28	10
14	29.7	5.1	.11	.12	9.1			0	.01	8.06	7.28	10
15	25.5	4.9	.12	.12	14.9					8.01	7.28	10

TABLE 2.1 (cont'd.) MAY 1984

DATE	TURBIDITY (FTU)				COAGULANT ALUM	COAG. AID	FILTER AID	METAL RES. Al (mg/L)		pH		TEMP. (oC)
	Raw	Set.	Filter	Treat.	mg/L	mg/L	mg/L	Raw	Treat.	Raw	Treat.	Raw
16	23.5	5.0	.13	.12	13.3					8.06	7.33	10
17	17.3	4.5	.12	.11	12.3					8.06	7.34	10
18	19.0	4.2	.12	.13	12.7					7.94	7.32	10
19	55.3	5.9	.15	.17	21.7					7.95	7.37	10
20	37.2	4.1	.16	.16	17.7					7.95	7.32	10
21	27.3	4.0	.14	.13	15.5			0	0	8.00	7.35	10
22	25.7	4.6	.12	.12	15.2					7.86	7.37	13
23	14.7	3.9	.13	.13	11.8					8.08	7.40	11
24	12.3	3.3	.12	.12	11.4					8.10	7.36	11
25	13.7	3.1	.13	.13	12.9					8.06	7.28	11
26	22.7	3.9	.15	.15	15.8					8.03	7.26	10
27	16.0	3.6	.16	.16	12.4					8.06	7.32	10
28	25.8	4.3	.17	.17	12.9			.02	.03	8.07	7.32	12
29	121.0	5.4	.13	.13	26.0					8.08	7.32	12
30	32.2	4.3	.12	.12	17.3					7.98	7.36	12
31	21.8	3.5	.12	.11	16.0					8.02	7.06	12

TABLE 2.1: PARTICULATE REMOVAL PROFILE JUNE 1984

MOE WPOS PROTOCOL

DATE	TURBIDITY (FTU)				COAGULANT ALUM	COAG. AID	FILTER AID	METAL RES. Al (mg/L)		pH		TEMP. (°C)
	Raw	Set.	Filter	Treat.	mg/L	mg/L	mg/L	Raw	Treat.	Raw	Treat.	Raw
1	14.5	3.5	.12	.12	12.3					8.05	7.24	11
2	11.5	3.1	.12	.12	10.4					8.06	7.30	12
3	13.2	3.5	.13	.13	10.5					8.00	7.32	12
4	9.2	2.6	.15	.15	10.2					8.14	7.42	12
5	9.8	2.6	.18	.18	10.6				.01	8.03	7.45	12
6	22.1	2.8	.16	.16	12.4					8.12	7.41	12
7	11.2	3.3	.17	.17	8.1					8.19	7.64	12
8	13.7	3.4	.19	.19	8.3					8.22	7.47	13
9	23.5	5.0	.21	.21	10.0					8.18	7.42	13
10	19.7	4.7	.20	.20	10.2					8.08	7.40	14
11	20.6	4.6	.20	.20	11.7				.03	8.03	7.60	13
12	8.3	2.9	.15	.15	8.4					8.04	7.58	12
13	17.9	3.7	.19	.19	10.4					8.08	7.49	13
14	11.0	3.6	.20	.19	8.1					8.11	7.69	13
15	8.8	2.9	.16	.16	7.3					8.25	7.24	12

TABLE 2.1 (cont'd.) JUNE 1984

DATE	TURBIDITY (FTU)				COAGULANT ALUM	COAG. AID	FILTER AID	METAL RES. Al (mg/L)		pH		TEMP. (oC)
	Raw	Set.	Filter	Treat.	mg/L	mg/L	mg/L	Raw	Treat.	Raw	Treat.	Raw
16	13.1	3.3	.17	.17	8.3					8.18	7.82	13
17	16.8	4.1	.14	.16	10.4					7.89	7.19	15
18	24.8	3.9	.14	.15	11.4					7.94	7.41	16
19	25.5	4.7	.14	.15	11.1					7.88	7.30	16
20	29.8	5.1	.15	.14	12.8					7.89	7.19	16
21	26.5	4.9	.14	.14	13.4					8.02	7.27	17
22	30.5	5.6	.17	.17	13.8					8.06	7.34	17
23	23.0	4.2	.16	.16	10.7					8.16	7.42	19
24	17.0	3.8	.14	.14	11.1					8.21	7.46	19
25	25.8	4.6	.14	.14	11.2					8.10	7.52	18
26	26.7	5.2	.13	.13	12.7					7.98	7.35	17
27	75.2	4.7	.14	.14	18.3					8.20	7.44	19
28	85.3	6.3	.13	.13	20.3					7.87	7.41	15
29	28.5	6.0	.18	.17	11.9					7.82	7.38	14
30	26.2	6.4	.21	.21	10.7					7.78	7.38	15
31												

TABLE 2.1: PARTICULATE REMOVAL PROFILE JULY 1984

MOE WPOS PROTOCOL

DATE	TURBIDITY (FTU)				COAGULANT ALUM	COAG. AID	FILTER AID	METAL RES. Al (mg/L)		pH		TEMP. (°C)
	Raw	Set.	Filter	Treat.	mg/L	mg/L	mg/L	Raw	Treat.	Raw	Treat.	Raw
1	30.0	6.5	.20	.22	11.6					7.85	7.47	15
2	20.3	5.6	.24	.23	9.7			0	.02	7.85	7.46	15
3	19.0	6.4	.27	.27	9.7					7.89	7.46	14
4	39.2	6.5	.22	.22	15.2					7.92	7.51	15
5	34.2	6.5	.16	.16	15.8					7.92	7.50	15
6	60.7	5.9	.14	.14	16.7					7.94	7.48	15
7	41.0	5.8	.14	.13	14.4					7.83	7.22	13
8	12.3	5.0	.21	.20	8.4					7.98	7.47	14
9	14.7	5.6	.24	.25	8.9					7.94	7.49	13
10	21.7	6.1	.27	.27	10.4					7.90	7.52	13
11	33.0	5.6	.19	.21	18.1					7.58	7.03	14
12	28.2	4.9	.15	.16	17.5					7.46	6.95	15
13	24.3	4.0	.15	.15	17.1					7.64	7.06	15
14	24.5	4.2	.15	.16	17.6					7.64	7.10	15
15	29.3	3.9	.12	.13	19.9					7.66	7.12	15

TABLE 2.1 (cont'd.) JULY 1984

DATE	TURBIDITY (FTU)				COAGULANT ALUM	COAG. AID	FILTER AID	METAL RES. Al (mg/L)		pH		TEMP. (oC)
	Raw	Set.	Filter	Treat.	mg/L	mg/L	mg/L	Raw	Treat.	Raw	Treat.	Raw
16	23.3	3.9	.12	.11	18.4					7.65	7.10	15
17	27.0	4.9	.16	.16	19.9					7.76	7.12	14
18	31.3	5.5	.15	.14	19.0					7.61	7.17	14
19	21.7	4.0	.15	.15	16.5					7.64	7.18	14
20	27.7	4.3	.17	.17	16.9					7.72	7.25	14
21	34.5	4.6	.15	.15	18.7					7.72	7.26	14
22	23.2	4.7	.17	.17	15.1					7.72	7.29	14
23	28.7	5.3	.16	.16	17.0					7.82	7.45	15
24	21.2	5.7	.16	.16	15.6					7.80	7.43	14
25	8.2	3.0	.16	.16	11.6					7.70	7.40	14
26	11.8	3.4	.13	.14	12.8					7.80	7.46	14
27	14.5	4.3	.17	.18	13.4					7.82	7.42	14
28	13.3	3.9	.20	.20	12.9					7.91	7.42	17
29	14.8	3.4	.19	.19	12.0					7.89	7.35	18
30	19.3	3.7	.19	.19	12.8			.02	.01	8.15	7.42	19
31	14.5	3.2	.18	.20	11.2					8.19	7.40	20

TABLE 2.1: PARTICULATE REMOVAL PROFILE AUGUST 1984.

MOE WPOS PROTOCOL

DATE	TURBIDITY (FTU)				COAGULANT ALUM	COAG. AID	FILTER AID	METAL RES. Al/Fe (mg/L)		pH		TEMP. (°C)
	Raw	Set.	Filter	Treat.	mg/L	mg/L	mg/L	Raw	Treat.	Raw	Treat.	Raw
1	19.7	3.6	.15	.15		13.2				8.16	7.38	20
2	16.2	3.0	.14	.14		11.9				7.99	7.09	21
3	9.4	2.2	.15	.15		11.6				8.01	7.09	21
4	12.3	2.2	.19	.20		12.8				8.03	7.22	21
5	10.0	1.7	.13	.14		15.5				8.03	7.22	22
6	13.2	2.1	.12	.12		12.3				7.97	7.45	22
7	15.8	3.0	.16	.15		12.5				7.50	7.03	20
8	13.7	3.3	.14	.15		11.5				7.68	7.19	20
9	13.7	3.1	.14	.14		11.4				7.50	6.91	19
10	14.5	3.6	.14	.14		11.9				7.62	7.02	20
11	13.8	3.2	.13	.13		11.0				7.73	7.16	19
12	13.8	2.6	.14	.14		12.9				7.94	7.16	21
13	18.0	2.7	.13	.13		13.1		.02	.02	8.13	7.26	23
14	19.0	3.3	.18	.18		12.9				8.26	7.31	23
15	14.0	2.4	.14	.14		12.8				8.35	7.39	24

TABLE 2.1 (cont'd.) AUGUST 1984

DATE	TURBIDITY (FTU)				COAGULANT ALUM	COAG. AID	FILTER AID	METAL RES. Al (mg/L)		pH		TEMP. (oC)
	Raw	Set.	Filter	Treat.	mg/L	mg/L	mg/L	Raw	Treat.	Raw	Treat.	Raw
16	19.8	3.2	.12	.12	13.0					7.84	7.35	24
17	16.8	2.5	.15	.15	13.1					7.83	7.29	21
18	17.2	2.8	.15	.15	13.0					7.86	7.21	22
19	14.7	2.0	.13	.13	13.1					7.78	7.20	22
20	19.5	2.3	.11	.11	13.0			.03	0	7.82	7.20	22
21	17.5	2.7	.13	.14	12.7					7.70	7.26	22
22	15.0	5.4	.16	.14	13.2					7.67	7.24	20
23	23.8	3.2	.16	.17	14.8					7.56	7.26	19
24	10.7	2.6	.15	.16	12.7					7.64	7.22	18
25	9.1	2.5	.15	.16	10.7					7.66	7.21	18
26	11.2	2.3	.15	.16	10.7					7.68	7.21	19
27	11.2	3.3	.13	.14	10.9			.03	.03	7.88	7.22	21
28	17.7	4.2	.12	.12	12.3					7.86	7.21	21
29	25.3	4.2	.12	.11	15.4					8.16	7.26	22
30	31.0	3.4	.13	.12	18.6					7.76	7.11	21
31	14.9	3.9	.13	.13	12.8					7.62	7.17	20

TABLE 2.1: PARTICULATE REMOVAL PROFILE SEPTEMBER 1984

MOE WPOS PROTOCOL

DATE	TURBIDITY (FTU)				COAGULANT ALUM	COAG. AID	FILTER AID	METAL RES. Al (mg/L)		pH		TEMP. (°C)
	Raw	Set.	Filter	Treat.	mg/L	mg/L	mg/L	Raw	Treat.	Raw	Treat.	Raw
1	9.0	2.9	.12	.12	10.9					7.38	7.02	18
2	24.9	3.2	.13	.13	15.1					7.76	7.06	20
3	21.8	3.4	.12	.12	15.2			.02	0	7.36	7.03	18
4	13.3	3.3	.15	.15	10.4					7.52	7.10	18
5	5.8	3.3	.13	.13	9.6					7.48	7.11	16
6	5.6	2.7	.15	.15	9.9					7.34	7.01	16
7	13.4	2.6	.14	.14	11.3					8.01	7.08	16
8	67.8	3.8	.16	.16	26.1					7.96	7.09	16
9	117.5	3.3	.14	.14	35.8					7.84	7.10	16
10	139.2	3.6	.13	.13	37.7			.01	.01	7.83	7.09	20
11	61.0	4.6	.15	.15	25.8					7.93	7.22	20
12	44.0	6.2	.16	.16	18.8					7.92	7.29	20
13	95.0	5.1	.12	.13	26.2					7.93	7.24	20
14	89.0	4.5	.09	.09	27.3					7.98	7.20	20
15	39.0	5.4	.13	.14	18.1					7.97	7.25	20

TABLE 2.1 (cont'd.) SEPTEMBER 1984

DATE	TURBIDITY (FTU)				COAGULANT ALUM	COAG. AID	FILTER AID	METAL RES. Al (mg/L)		pH		TEMP. (oC)
	Raw	Set.	Filter	Treat.	mg/L	mg/L	mg/L	Raw	Treat.	Raw	Treat.	Raw
16	39.0	5.2	.15	.16	18.4					7.97	7.25	19
17	19.0	3.2	.12	.12	12.4			.02	.01	8.08	7.29	19
18	18.0	3.4	.14	.13	12.8					8.11	7.31	19
19	14.0	3.3	.15	.16	11.0					8.00	7.34	19
20	32.3	3.9	.15	.14	17.0					8.04	7.50	19
21	14.8	3.7	.16	.18	11.7					8.00	7.38	19
22	24.3	4.1	.18	.18	14.3					8.07	7.35	19
23	18.3	3.5	.19	.20	13.4					8.08	7.33	19
24	13.2	3.0	.19	.20	10.7			.01	.01	8.04	7.38	20
25	32.7	4.4	.16	.16	15.0					7.95	7.40	20
26	26.8	4.0	.13	.14	16.3					8.05	7.43	19
27	19.3	4.8	.14	.15	9.7					8.05	7.25	19
28	12.3	4.4	.21	.20	7.8					7.99	7.27	18
29	13.5	5.2	.22	.20	7.1					7.98	7.31	18
30	10.7	4.7	.24	.22	7.3					8.10	7.38	17
31												

TABLE 2.1: PARTICULATE REMOVAL PROFILE OCTOBER 1984

MOE WPOS PROTOCOL

DATE	TURBIDITY (FTU)				COAGULANT ALUM	COAG. AID	FILTER AID	METAL RES. Al (mg/L)		pH		TEMP. (°C)
	Raw	Set.	Filter	Treat.	mg/L	mg/L	mg/L	Raw	Treat.	Raw	Treat.	Raw
1	10.7	4.3	.22	.23	6.5			0	.02	8.09	7.33	17
2	15.9	5.3	.23	.24	8.0					8.14	7.42	16
3	89.7	6.4	.16	.17	16.1					8.06	7.33	16
4	57.2	6.1	.17	.18	15.8					8.12	7.38	16
5	45.2	6.4	.18	.17	19.0					8.08	7.27	16
6	39.0	7.2	.19	.19	12.6					8.03	7.30	16
7	40.6	5.2	.21	.22	11.8					8.04	7.36	16
8	55.6	4.3	.14	.17	13.4			.01	0	8.03	7.36	16
9	55.2	5.5	.17	.17	16.1					7.95	7.35	17
10	30.5	5.9	.19	.16	10.8					7.96	7.33	16
11	17.8	3.9	.21	.18	8.7					7.86	7.42	16
12	22.3	5.2	.20	.19	10.1					7.89	7.40	17
13	12.0	4.1	.18	.18	7.7					7.88	7.35	16
14	10.8	3.8	.20	.18	6.3					7.89	7.40	16
15	12.0	3.7	.22	.22	8.3			.03	.02	7.97	7.38	16

TABLE 2.1 (cont'd.) OCTOBER 1984

DATE	TURBIDITY (FTU)				COAGULANT ALUM	COAG. AID	FILTER AID	METAL RES. Al (mg/L)		pH		TEMP. (oC)
	Raw	Set.	Filter	Treat.	mg/L	mg/L	mg/L	Raw	Treat.	Raw	Treat.	Raw
16	8.7	3.1	.14	.14	7.4					7.89	7.46	17
17	7.6	3.1	.15	.15	7.8					8.12	7.55	18
18	6.6	3.4	.16	.16	7.9					8.07	7.50	17
19	15.7	3.7	.17	.17	9.0					8.15	7.47	17
20	24.7	4.6	.15	.15	10.9					8.11	7.51	17
21	74.8	5.2	.16	.16	14.9			0	.02	8.00	7.36	17
22	55.0	5.6	.16	.16	15.9					8.04	7.44	17
23	27.0	5.1	.16	.15	10.8					7.83	7.38	17
24	26.0	5.2	.13	.13	11.4					8.00	7.38	16
25	17.0	4.6	.13	.13	9.3					8.06	7.41	16
26	35.5	5.1	.15	.15	12.2					8.07	7.50	15
27	26.8	4.7	.16	.18	11.9					8.04	7.39	16
28	24.5	4.4	.14	.15	10.1					8.06	7.47	16
29	14.6	4.4	.15	.16	9.3			0	.03	8.00	7.36	16
30	19.3	4.6	.16	.16	10.2					8.03	7.42	15
31	24.7	5.2	.13	.13	11.5					8.00	7.42	15

TABLE 2.1: PARTICULATE REMOVAL PROFILE NOVEMBER 1984

MOE WPOS PROTOCOL

DATE	TURBIDITY (FTU)				COAGULANT ALUM	COAG. AID	FILTER AID	METAL RES. Al (mg/L)		pH		TEMP. (°C)
	Raw	Set.	Filter	Treat.	mg/L	mg/L	mg/L	Raw	Treat.	Raw	Treat.	Raw
1	86.7	5.4	.13	.15	18.1					8.04	7.48	15
2	143.3	7.6	.11	.11	23.0					8.03	7.39	15
3	47.0	7.5	.14	.14	12.4					8.01	7.37	14
4	151.8	8.4	.13	.14	22.6					8.01	7.32	14
5	163.4	8.6	.11	.11	22.8			.03	.01	7.97	7.36	13
6	62.3	8.0	.14	.15	16.3					8.04	7.38	13
7	58.0	8.7	.13	.14	15.5					7.93	7.35	14
8	76.7	9.0	.13	.13	18.9					7.88	7.45	12
9	148.0	8.1	.10	.10	24.7					7.93	7.42	13
10	138.0	6.6	.12	.11	21.3					8.02	7.44	13
11	133.0	7.5	.13	.12	24.2					8.05	7.43	13
12	133.0	7.8	.10	.10	24.7			.02	0	7.88	7.39	12
13	93.0	7.8	.11	.11	19.6					7.76	7.45	11
14	64.1	8.9	.12	.14	17.0					8.03	7.41	11
15	214.0	10.0	.17	.17	23.4					7.96	7.36	11

TABLE 2.1 (cont'd.) NOVEMBER 1984

DATE	TURBIDITY (FTU)				COAGULANT ALUM	COAG. AID	FILTER AID	METAL RES. Al (mg/L)		pH		TEMP. (oC)
	Raw	Set.	Filter	Treat.	mg/L	mg/L	mg/L	Raw	Treat.	Raw	Treat.	Raw
16	194.0	8.0	.14	.14	21.4					7.96	7.34	11
17	104.0	8.6	.14	.14	16.1					7.58	7.32	11
18	59.3	7.5	.14	.14	7.9					7.96	7.37	10
19	37.8	7.5	.16	.16	10.8			0	0	7.81	7.38	10
20	26.2	7.2	.15	.15	9.8					7.73	7.36	9
21	27.2	7.5	.14	.14	10.6					7.85	7.42	10
22	29.2	7.8	.18	.18	10.9					7.87	7.38	9
23	71.7	7.0	.15	.15	15.0					7.85	7.31	10
24	30.7	6.9	.14	.14	9.5					7.95	7.50	9
25	34.0	6.4	.15	.15	13.8					8.00	7.52	10
26	28.8	7.6	.16	.15	11.3			.02	0	7.86	7.40	9
27	38.7	7.4	.16	.18	13.3					7.97	7.39	9
28	85.2	7.4	.13	.14	18.5					8.12	7.44	9
29	64.8	6.9	.13	.15	14.8					8.08	7.41	9
30	57.0	7.4	.13	.14	12.8					7.98	7.39	9
31												

TABLE 2.1: PARTICULATE REMOVAL PROFILE DECEMBER 1984

MOE WPOS PROTOCOL

DATE	TURBIDITY (FTU)				COAGULANT ALUM	COAG. AID	FILTER AID	METAL RES. Al (mg/L)		pH		TEMP. (°C)
	Raw	Set.	Filter	Treat.	mg/L	mg/L	mg/L	Raw	Treat.	Raw	Treat.	Raw
1	52.8	6.3	.14	.14	14.2					8.03	7.41	9
2	36.0	6.5	.12	.13	10.6					8.01	7.39	9
3	56.8	6.1	.14	.12	16.0			0	0	8.06	7.52	9
4	68.7	7.0	.13	.14	15.8					8.06	7.39	8
5	51.8	7.2	.15	.16	12.1					7.91	7.37	7
6	20.0	7.6	.19	.21	8.7					7.91	7.44	7
7	41.0	7.0	.14	.15	12.7					7.98	7.48	7
8	159.0	7.8	.13	.14	21.8					7.96	7.47	7
9	48.8	8.7	.18	.16	12.4					7.94	7.43	7
10	95.6	10.7	.14	.17	20.0					7.92	7.50	6
11	55.3	9.8	.13	.14	15.2			0	0	7.88	7.44	6
12	84.3	9.6	.18	.20	16.7					7.65	7.30	6
13	76.0	8.7	.18	.18	17.1					7.70	7.27	6
14	71.2	10.9	.19	.19	15.9					7.68	7.27	6
15	78.8	9.8	.19	.19	19.4					7.71	7.29	7

TABLE 2.1 (cont'd.) DECEMBER 1984

DATE	TURBIDITY (FTU)				COAGULANT ALUM	COAG. AID	FILTER AID	METAL RES. Al (mg/L)		pH		TEMP. (oC)
	Raw	Set.	Filter	Treat.	mg/L	mg/L	mg/L	Raw	Treat.	Raw	Treat.	Raw
16	41.8	8.9	.18	.18	12.6					7.76	7.40	7
17	103.0	8.8	.19	.19	20.9			.02	0	7.64	7.29	7
18	43.0	8.6	.14	.14	14.5					7.75	7.33	7
19	42.7	9.0	.19	.19	14.5					7.80	7.38	8
20	72.7	9.7	.18	.20	16.8					7.84	7.33	8
21	48.8	9.5	.18	.18	12.1					7.70	7.35	6
22	96.8	10.8	.18	.18	14.7					7.65	7.33	6
23	93.0	17.3	1.09	.39	13.0					7.84	7.32	6
24	142.2	12.5	.20	.32	21.5			.02	.04	7.80	7.35	7
25	53.7	8.5	.15	.18	18.9					7.83	7.34	5
26	61.7	6.1	.13	.15	18.8					7.80	7.33	5
27	52.2	8.2	.13	.15	20.7					7.79	7.43	5
28	90.3	6.1	.14	.15	29.5					7.96	7.38	5
29	84.2	6.3	.15	.16	29.7					7.88	7.32	5
30	75.3	6.7	.14	.15	27.7					7.89	7.31	5
31	53.2	8.7	.14	.14	21.4			.02	0	7.93	7.39	5

TABLE 3

WATER PLANT OPTIMIZATION STUDY

"DISINFECTION SUMMARY"

TABLE 3.0: DISINFECTION SUMMARY (mg/L)

MOE WPOS PROTOCOL

		1986						1985					
		PRE-CHLORINATION			POST-CHLORINATION			PRE-CHLORINATION			POST-CHLORINATION		
		Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.
JAN	Cl_2 Demand												
	Cl_2 Dosage	1.57	0.93	1.18	0.44	0.21	0.27	1.41	0.84	1.11	0.38	0.19	0.25
	Ammonia												
	SO_2												
	Resid. Cl_2 Free				0.83	0.58	0.71				0.91	0.65	0.76
	Resid. Cl_2 Comb.												
	Resid. Cl_2 Total	0.83	0.68	0.76	0.92	0.81	0.86	0.80	0.68	0.74	1.00	0.80	0.87
FEB	Cl_2 Demand												
	Cl_2 Dosage	1.78	1.07	1.32	0.40	0.24	0.31	1.48	0.77	1.13	0.31	0.22	0.24
	Ammonia												
	SO_2												
	Resid. Cl_2 Free				0.84	0.62	0.72				0.83	0.68	0.74
	Resid. Cl_2 Comb.												
	Resid. Cl_2 Total	0.80	0.69	0.74	0.94	0.80	0.86	0.79	0.67	0.73	0.91	0.81	0.85
MAR	Cl_2 Demand												
	Cl_2 Dosage	1.80	0.97	1.37	0.36	0.21	0.28	1.58	0.96	1.25	0.34	0.23	0.29
	Ammonia												
	SO_2												
	Resid. Cl_2 Free				0.88	0.63	0.72				0.91	0.65	0.75
	Resid. Cl_2 Comb.												
	Resid. Cl_2 Total	0.84	0.71	0.77	1.00	0.81	0.90	0.83	0.71	0.79	0.95	0.83	0.89

TABLE 3.0 (cont'd.) (mg/L)

		1986						1985					
		PRE-CHLORINATION			POST-CHLORINATION			PRE-CHLORINATION			POST-CHLORINATION		
		Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.
APR	Cl_2 Demand												
	Cl_2 Dosage	1.67	1.12	1.36	0.60	0.27	0.40	1.44	0.76	1.22	0.31	0.23	0.27
	Ammonia												
	SO_2												
	Resid. Cl_2 Free				0.90	0.54	0.80				0.83	0.66	0.74
	Resid. Cl_2 Comb.												
	Resid. Cl_2 Total	0.82	0.68	0.75	1.04	0.90	0.96	0.80	0.73	0.76	0.91	0.81	0.86
MAY	Cl_2 Demand												
	Cl_2 Dosage	1.94	1.11	1.45	0.41	0.27	0.34	1.77	1.07	1.27	0.42	0.24	0.31
	Ammonia												
	SO_2												
	Resid. Cl_2 Free				0.89	0.54	0.77				0.86	0.54	0.71
	Resid. Cl_2 Comb.												
	Resid. Cl_2 Total	0.85	0.64	0.77	1.02	0.88	0.95	0.81	0.69	.74	0.93	0.69	0.85
JUN	Cl_2 Demand												
	Cl_2 Dosage	2.26	1.46	1.73	0.50	0.31	0.38	1.78	1.19	1.46	0.43	0.23	0.34
	Ammonia												
	SO_2												
	Resid. Cl_2 Free				0.90	0.62	0.78				0.86	0.58	0.70
	Resid. Cl_2 Comb.												
	Resid. Cl_2 Total	0.85	0.68	0.76	1.07	0.88	0.97	0.84	0.69	0.76	0.98	0.80	0.88

TABLE 3.0 (cont'd.) (mg/L)

		1986						1985					
		PRE-CHLORINATION			POST-CHLORINATION			PRE-CHLORINATION			POST-CHLORINATION		
		Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.
JUL	Cl_2 Demand												
	Cl_2 Dosage	2.60	1.42	1.79	0.60	0.31	0.39	1.97	1.29	1.67	0.57	0.32	0.43
	Ammonia												
	SO_2												
	Resid. Cl_2 Free				0.93	0.68	0.77				0.87	0.63	0.76
	Resid. Cl_2 Comb.												
	Resid. Cl_2 Total	0.94	0.67	0.77	1.02	0.89	0.95	0.88	0.67	0.76	1.07	0.84	0.93
AUG	Cl_2 Demand												
	Cl_2 Dosage	2.12	1.37	1.70	0.48	0.32	0.37	3.2	1.46	1.62	0.70	0.28	0.44
	Ammonia												
	SO_2												
	Resid. Cl_2 Free				0.88	0.70	0.82				1.04	0.66	0.79
	Resid. Cl_2 Comb.												
	Resid. Cl_2 Total	0.85	0.69	0.79	1.03	0.91	0.97	1.00	0.69	0.76	1.20	0.86	0.94
SEP	Cl_2 Demand												
	Cl_2 Dosage	2.33	1.30	1.72	0.51	0.27	0.38	1.95	0.99	1.65	0.58	0.34	0.43
	Ammonia												
	SO_2												
	Resid. Cl_2 Free				0.88	0.69	0.79				0.93	0.71	0.82
	Resid. Cl_2 Comb.												
	Resid. Cl_2 Total	0.88	0.71	0.78	1.02	0.91	0.96	0.94	0.68	0.78	1.08	0.90	0.96

TABLE 3.0 (cont'd.) (mg/L)

		1986						1985					
		PRE-CHLORINATION			POST-CHLORINATION			PRE-CHLORINATION			POST-CHLORINATION		
		Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.
OCT	Cl_2 Demand												
	Cl_2 Dosage	1.99	0.93	1.51	0.46	0.30	0.37	2.00	1.17	1.50	0.50	0.39	0.45
	Ammonia												
	SO_2												
	Resid. Cl_2 Free				0.89	0.70	0.80				0.96	0.68	0.81
	Resid. Cl_2 Comb.												
	Resid. Cl_2 Total	0.91	0.71	0.77	1.07	0.90	0.96	0.81	0.71	0.76	1.02	0.92	0.96
NOV	Cl_2 Demand												
	Cl_2 Dosage	1.99	1.07	1.46	0.38	0.28	0.33	1.64	1.21	1.39	0.53	0.32	0.42
	Ammonia												
	SO_2												
	Resid. Cl_2 Free				0.92	0.70	0.78				0.89	0.63	0.78
	Resid. Cl_2 Comb.												
	Resid. Cl_2 Total	0.82	0.70	0.76	1.02	0.90	0.94	0.83	0.72	0.77	1.03	0.87	0.95
DEC	Cl_2 Demand												
	Cl_2 Dosage	1.49	0.92	1.17	0.42	0.20	0.34	1.56	0.93	1.24	0.43	0.29	0.34
	Ammonia												
	SO_2												
	Resid. Cl_2 Free				0.86	0.53	0.79				0.87	0.67	0.77
	Resid. Cl_2 Comb.												
	Resid. Cl_2 Total	0.78	0.65	0.71	1.00	0.88	0.91	0.81	0.64	0.75	0.98	0.81	0.91

TABLE 3.1: DISINFECTION SUMMARY (mg/L)

MOE WPOS PROTOCOL

		1984						1983					
		PRE-CHLORINATION			POST-CHLORINATION			PRE-CHLORINATION			POST-CHLORINATION		
		Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.
JAN	Cl_2 Demand												
	Cl_2 Dosage	2.51	1.02	1.30	0.40	0.27	0.33						
	Ammonia												
	SO_2												
	Resid. Cl_2 Free				0.90	0.70	0.82						
	Resid. Cl_2 Comb.												
	Resid. Cl_2 Total	0.79	0.64	0.72	1.03	0.88	0.96						
FEB	Cl_2 Demand												
	Cl_2 Dosage	1.70	1.23	1.47	0.40	0.23	0.31						
	Ammonia												
	SO_2												
	Resid. Cl_2 Free				1.01	0.71	0.85						
	Resid. Cl_2 Comb.												
	Resid. Cl_2 Total	0.89	0.66	0.73	1.05	0.89	0.96						
MAR	Cl_2 Demand												
	Cl_2 Dosage	2.90	1.01	1.41	0.46	0.25	0.31						
	Ammonia												
	SO_2												
	Resid. Cl_2 Free				0.95	0.13	0.72						
	Resid. Cl_2 Comb.												
	Resid. Cl_2 Total	1.35	0.67	.79	1.05	0.84	0.95						

TABLE 3.1 (cont'd.) (mg/L)

		1984						1983					
		PRE-CHLORINATION			POST-CHLORINATION			PRE-CHLORINATION			POST-CHLORINATION		
		Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.
APR	Cl_2 Demand												
	Cl_2 Dosage	2.33	1.12	1.53	0.34	0.17	0.23						
	Ammonia												
	SO_2												
	Resid. Cl_2 Free				1.01	0.63	0.79						
	Resid. Cl_2 Comb.												
	Resid. Cl_2 Total	0.93	0.70	0.79	1.10	0.85	0.93						
MAY	Cl_2 Demand												
	Cl_2 Dosage	1.77	1.15	1.36	0.42	0.22	0.35						
	Ammonia												
	SO_2												
	Resid. Cl_2 Free				0.94	0.69	0.80						
	Resid. Cl_2 Comb.												
	Resid. Cl_2 Total	0.82	0.70	0.77	1.06	0.89	0.95						
JUN	Cl_2 Demand												
	Cl_2 Dosage	2.01	1.20	1.54	0.49	0.30	0.40						
	Ammonia												
	SO_2												
	Resid. Cl_2 Free				0.89	0.68	0.77						
	Resid. Cl_2 Comb.												
	Resid. Cl_2 Total	0.86	0.66	0.76	1.06	0.90	0.95						

TABLE 3.1 (cont'd.) (mg/L)

		1984						1983					
		PRE-CHLORINATION			POST-CHLORINATION			PRE-CHLORINATION			POST-CHLORINATION		
		Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.
JUL	Cl_2 Demand												
	Cl_2 Dosage	1.86	1.34	1.57	0.60	0.36	0.46						
	Ammonia												
	SO_2												
	Resid. Cl_2 Free				0.97	0.71	0.79						
	Resid. Cl_2 Comb.												
	Resid. Cl_2 Total	0.83	0.67	0.75	1.05	0.90	0.96						
AUG	Cl_2 Demand												
	Cl_2 Dosage	2.06	1.15	1.56	0.60	0.30	0.43						
	Ammonia												
	SO_2												
	Resid. Cl_2 Free				0.96	0.71	0.80						
	Resid. Cl_2 Comb.												
	Resid. Cl_2 Total	0.91	0.63	0.76	1.06	0.91	0.97						
SEP	Cl_2 Demand												
	Cl_2 Dosage	1.92	1.32	1.55	0.53	0.30	0.41						
	Ammonia												
	SO_2												
	Resid. Cl_2 Free				0.96	0.70	0.81						
	Resid. Cl_2 Comb.												
	Resid. Cl_2 Total	0.85	0.68	0.76	1.05	0.89	0.97						

TABLE 3.1 (cont'd.) (mg/L)

		1984						1983					
		PRE-CHLORINATION			POST-CHLORINATION			PRE-CHLORINATION			POST-CHLORINATION		
		Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.
OCT	Cl_2 Demand												
	Cl_2 Dosage	2.36	1.01	1.52	0.65	0.34	0.41						
	Ammonia												
	SO_2												
	Resid. Cl_2 Free				0.93	0.69	0.81						
	Resid. Cl_2 Comb.												
	Resid. Cl_2 Total	0.84	0.66	0.76	1.10	0.90	0.97						
NOV	Cl_2 Demand												
	Cl_2 Dosage	1.63	1.08	1.26	0.46	0.28	0.34						
	Ammonia												
	SO_2												
	Resid. Cl_2 Free				0.90	0.74	0.81						
	Resid. Cl_2 Comb.												
	Resid. Cl_2 Total	0.87	0.67	0.75	1.05	0.90	0.96						
DEC	Cl_2 Demand												
	Cl_2 Dosage	1.87	0.91	1.20	0.36	0.29	0.33						
	Ammonia												
	SO_2												
	Resid. Cl_2 Free				0.92	0.71	0.82						
	Resid. Cl_2 Comb.												
	Resid. Cl_2 Total	0.80	0.68	0.75	1.01	0.84	0.95						

TABLE 3.2: DISINFECTION PROFILE JANUARY 1986 (mg/L)

MOE WPOS PROTOCOL

DATE	PRE-CHLORINATION							POST-CHLORINATION						
	Cl_2		NH_3	SO_2	RESIDUAL Cl_2			Cl_2		NH_3	SO_2	RESIDUAL Cl_2		
	Dem.	Dos.			Free	Comb.	Total	Dem.	Dos.			Free	Comb.	Total
1		1.57					.68		.44			.72		.84
2		1.29					.78		.29			.83		.93
3		1.19					.75		.26			.71		.90
4		1.24					.77		.28			.74		.88
5		1.11					.77		.28			.70		.85
6		1.42					.83		.27			.73		.89
7		1.13					.70		.27			.69		.87
8		1.24					.76		.31			.73		.87
9		1.03					.72		.29			.69		.85
10		1.01					.74		.29			.70		.87
11		1.09					.79		.27			.76		.91
12		1.02					.73		.24			.75		.85
13		1.29					.78		.27			.75		.83
14		1.13					.74		.22			.74		.82
15		1.05					.74		.21			.70		.83

TABLE 3.2 (cont'd.) JANUARY 1986 (mg/L)

DATE	PRE-CHLORINATION							POST-CHLORINATION						
	Cl_2		NH_3	SO_2	RESIDUAL Cl_2			Cl_2		NH_3	SO_2	RESIDUAL Cl_2		
	Dem.	Dos.			Free	Comb.	Total	Dem.	Dos.			Free	Comb.	Total
16		1.23					.73		.24			.66		.83
17		1.16					.75		.27			.73		.85
18		0.99					.78		.27			.69		.88
19		0.99					.75		.27			.67		.82
20		0.93					.75		.26			.62		.81
21		1.33					.73		.27			.58		.82
22		1.29					.75		.27			.61		.83
23		1.27					.79		.27			.70		.88
24		0.54					.72		.27			.66		.83
25		0.99					.80		.27			.76		.87
26		1.18					.74		.29			.69		.84
27		1.43					.80		.29			.80		.92
28		1.43					.81		.29			.72		.91
29		1.21					.75		.28			.72		.86
30		1.36					.78		.27			.78		.90
31		1.29					.74		.24			.66		.83

TABLE 3.2: DISINFECTION PROFILE FEBRUARY 1986 (mg/L)

MOE WPOS PROTOCOL

DATE	PRE-CHLORINATION							POST-CHLORINATION						
	Cl_2		NH_3	SO_2	RESIDUAL Cl_2			Cl_2		NH_3	SO_2	RESIDUAL Cl_2		
	Dem.	Dos.			Free	Comb.	Total	Dem.	Dos.			Free	Comb.	Total
1		1.40					.76		.25			.69		.87
2		1.23					.79		.31			.69		.86
3		1.10					.73		.24			.73		.84
4		1.19					.71		.28			.66		.80
5		1.21					.77		.32			.74		.91
6		1.02					.76		.26			.74		.90
7		1.15					.77		.31			.79		.88
8		1.25					.73		.30			.69		.87
9		1.78					.75		.32			.69		.85
10		1.27					.78		.29			.81		.91
11		1.15					.74		.25			.67		.81
12		1.26					.75		.29			.77		.86
13		1.35					.71		.30			.79		.84
14		1.19					.72		.31			.71		.84
15		1.44					.73		.31			.71		.85

TABLE 3.2 (cont'd.) FEBRUARY 1986 (mg/L)

DATE	PRE-CHLORINATION							POST-CHLORINATION						
	Cl_2		NH_3	SO_2	RESIDUAL Cl_2			Cl_2		NH_3	SO_2	RESIDUAL Cl_2		
	Dem.	Dos.			Free	Comb.	Total	Dem.	Dos.			Free	Comb.	Total
16		1.24					.73		.33			.66		.85
17		1.07					.73		.33			.64		.83
18		1.21					.71		.31			.80		.85
19		1.13					.69		.35			.76		.83
20		1.44					.75		.34			.82		.87
21		1.73					.76		.31			.84		.91
22		1.48					.78		.29			.77		.90
23		1.34					.74		.31			.71		.83
24		1.39					.73		.32			.70		.89
25		1.53					.71		.39			.62		.86
26		1.46					.72		.39			.73		.87
27		1.41					.73		.40			.66		.88
28		1.40					.80		.32			.75		.94
29														
30														
31														

TABLE 3.2: DISINFECTION PROFILE MARCH 1986 (mg/L)

MOE WPOS PROTOCOL

DATE	PRE-CHLORINATION							POST-CHLORINATION						
	Cl_2		NH_3	SO_2	RESIDUAL Cl_2			Cl_2		NH_3	SO_2	RESIDUAL Cl_2		
	Dem.	Dos.			Free	Comb.	Total	Dem.	Dos.			Free	Comb.	Total
1		1.70					.76		.28			.81		.88
2		1.32					.72		.27			.79		.87
3		1.44					.79		.31			.83		.89
4		1.36					.77		.29			.80		.87
5		1.39					.70		.26			.75		.89
6		1.44					.81		.26			.63		.90
7		1.44					.80		.27			.75		.92
8		1.29					.78		.26			.79		.90
9		1.06					.76		.24			.66		.88
10		1.32					.73		.22			.68		.85
11		1.32					.75		.26			.71		.86
12		1.35					.73		.27			.68		.86
13		0.97					.84		.23			.75		.93
14		1.80					.74		.32			.77		.85
15		1.59					.71		.33			.73		.81

TABLE 3.2 (cont'd.) MARCH 1986 (mg/L)

DATE	PRE-CHLORINATION							POST-CHLORINATION						
	Cl_2		NH_3	SO_2	RESIDUAL Cl_2			Cl_2		NH_3	SO_2	RESIDUAL Cl_2		
	Dem.	Dos.			Free	Comb.	Total	Dem.	Dos.			Free	Comb.	Total
16		1.34					.78		.21			.76		.87
17		1.28					.77		.21			.77		.89
18		1.57					.72		.27			.70		.84
19		1.52					.80		.28			.83		.94
20		1.52					.71		.25			.64		.87
21		1.44					.71		.25			.71		.92
22		1.47					.83		.35			.78		.98
23		1.36					.75		.31			.71		.94
24		1.19					.75		.30			.68		.90
25		1.30					.73		.30			.69		.90
26		1.16					.74		.31			.78		.92
27		1.62					.75		.33			.84		.93
28		1.46					.78		.36			.75		.98
29		1.40					.75		.28			.78		.93
30		1.35					.75		.34			.81		.92
31		1.42					.84		.32			.88		1.00

TABLE 3.2: DISINFECTION PROFILE APRIL 1986 (mg/L)

MOE WPOS PROTOCOL

DATE	PRE-CHLORINATION							POST-CHLORINATION						
	Cl_2		NH_3	SO_2	RESIDUAL Cl_2			Cl_2		NH_3	SO_2	RESIDUAL Cl_2		
	Dem.	Dos.			Free	Comb.	Total	Dem.	Dos.			Free	Comb.	Total
1		1.33					.78		.31			.78		.97
2		1.12					.75		.27			.71		.91
3		1.40					.72		.34			.73		.91
4		1.23					.74		.41			.77		.95
5		1.29					.78		.42			.82		1.01
6		1.33					.69		.41			.75		.92
7		1.32					.73		.37			.87		.96
8		1.38					.77		.37			.89		.99
9		1.27					.76		.31			.84		.93
10		1.67					.74		.31			.72		.91
11		1.38					.74		.33			.72		.90
12		1.35					.82		.32			.89		1.00
13		1.43					.76		.32			,76		.95
14		1.43					.78		.32			.77		.95
15		1.45					.78		.32			.79		.98

TABLE 3.2 (cont'd.) APRIL 1986 (mg/L)

DATE	PRE-CHLORINATION							POST-CHLORINATION						
	Cl_2		NH_3	SO_2	RESIDUAL Cl_2			Cl_2		NH_3	SO_2	RESIDUAL Cl_2		
	Dem.	Dos.			Free	Comb.	Total	Dem.	Dos.			Free	Comb.	Total
16		1.37					.73		.44			.82		.97
17		1.23					.76		.48			.88		1.02
18		1.15					.75		.45			.54		.99
19		1.42					.68		.48			.86		.95
20		1.34					.72		.47			.86		.94
21		1.48					.73		.50			.87		.97
22		1.40					.71		.46			.81		1.00
23		1.25					.75		.46			.90		.99
24		1.24					.76		.48			.85		.98
25		1.23					.69		.60			.74		.92
26		1.57					.75		.46			.85		.99
27		1.36					.72		.48			.82		.98
28		1.52					.70		.48			.76		.95
29		1.49					.79		.41			.86		1.04
30		1.42					.78		.36			.73		.92
31														

TABLE 3.2: DISINFECTION PROFILE MAY 1986 (mg/L)

MOE WPOS PROTOCOL

DATE	PRE-CHLORINATION							POST-CHLORINATION						
	Cl_2		NH_3	SO_2	RESIDUAL Cl_2			Cl_2		NH_3	SO_2	RESIDUAL Cl_2		
	Dem.	Dos.			Free	Comb.	Total	Dem.	Dos.			Free	Comb.	Total
1		1.54					.77		.27			.78		.90
2		1.45					.83		.28			–		.98
3		1.54					.78		.30			–		.96
4		1.54					.77		.31			–		.93
5		1.45					.76		.31			–		.95
6		1.22					.83		.31			.77		.97
7		1.49					.85		.32			.54		.99
8		1.25					.78		.31			.78		.93
9		1.53					.76		.34			.79		.92
10		1.38					.75		.37			.68		.91
11		1.30					.76		.37			.71		.95
12		1.46					.77		.35			.78		.95
13		1.60					.82		.36			.88		.99
14		1.57					.81		.34			.89		.99
15		1.31					.76		.31			.87		.93

TABLE 3.2 (cont'd.) MAY 1986 (mg/L)

DATE	PRE-CHLORINATION							POST-CHLORINATION						
	Cl_2		NH_3	SO_2	RESIDUAL Cl_2			Cl_2		NH_3	SO_2	RESIDUAL Cl_2		
	Dem.	Dos.			Free	Comb.	Total	Dem.	Dos.			Free	Comb.	Total
16		1.44					.75		.31			.81		.95
17		1.34					.79		.34			.78		.98
18		1.37					.74		.35			.69		.91
19		1.41					.75		.35			.72		.94
20		1.11					.71		.31			.67		.88
21		1.31					.78		.35			.75		.94
22		1.33					.73		.34			.72		.92
23		1.52					.78		.32			.76		.96
24		1.36					.75		.34			.81		.93
25		1.42					.76		.36			.81		.91
26		1.45					.72		.38			.81		.93
27		1.56					.75		.39			.86		.95
28		1.46					.79		.39			.78		.96
29		1.64					.75		.40			.79		1.00
30		1.69					.64		.40			.75		.95
31		1.94					.73		.41			.82		1.02

TABLE 3.2: DISINFECTION PROFILE JUNE 1986 (mg/L)

MOE WPOS PROTOCOL

DATE	PRE-CHLORINATION							POST-CHLORINATION						
	Cl_2		NH_3	SO_2	RESIDUAL Cl_2			Cl_2		NH_3	SO_2	RESIDUAL Cl_2		
	Dem.	Dos.			Free	Comb.	Total	Dem.	Dos.			Free	Comb.	Total
1		1.82					.77		.39			.82		.97
2		1.58					.76		.33			.76		1.00
3		1.90					.72		.33			.73		.91
4		1.78					.84		.33			.80		1.02
5		1.86					.77		.32			.66		.95
6		1.75					.80		.46			.70		.95
7		1.62					.83		.36			.90		1.02
8		1.46					.68		.37			.68		.89
9		1.82					.74		.43			.80		.98
10		1.67					.74		.46			.82		1.02
11		1.80					.79		.43			.76		1.02
12		1.50					.85		.31			.88		1.07
13		1.62					.75		.35			.81		.97
14		1.46					.70		.36			.69		.88
15		1.65					.79		.36			.74		.98

TABLE 3.2 (cont'd.) JUNE 1986 (mg/L)

DATE	PRE-CHLORINATION							POST-CHLORINATION						
	Cl_2		NH_3	SO_2	RESIDUAL Cl_2			Cl_2		NH_3	SO_2	RESIDUAL Cl_2		
	Dem.	Dos.			Free	Comb.	Total	Dem.	Dos.			Free	Comb.	Total
16		1.84					.75		.36			.78		.95
17		1.87					.81		.36			.78		.98
18		1.85					.75		.37			.86		.96
19		1.73					.72		.38			.83		.92
20		1.72					.74		.34			.74		.96
21		1.66					.71		.33			.62		.91
22		1.87					.79		.39			.80		.97
23		1.97					.74		.42			.71		.97
24		1.51					.79		.50			.82		1.01
25		1.78					.75		.36			.77		.96
26		2.26					.77		.45			.72		.92
27		1.52					.77		.39			.76		.95
28		1.71					.77		.38			.75		.97
29		1.52					.80		.39			.84		1.03
30		1.81					.74		.38			.84		.93
31														

TABLE 3.2: DISINFECTION PROFILE JULY 1986 (mg/L)

MOE WPOS PROTOCOL

DATE	PRE-CHLORINATION							POST-CHLORINATION						
	Cl_2		NH_3	SO_2	RESIDUAL Cl_2			Cl_2		NH_3	SO_2	RESIDUAL Cl_2		
	Dem.	Dos.			Free	Comb.	Total	Dem.	Dos.			Free	Comb.	Total
1		1.73					.80		.33			.88		.99
2		1.53					.77		.32			.93		.97
3		1.63					.72		.36			.73		.92
4		1.69					.73		.34			.73		.89
5		1.69					.77		.31			.73		.91
6		1.42					.77		.33			.82		.93
7		1.74					.75		.42			.70		.93
8		1.49					.75		.42			.84		.96
9		1.87					.79		.41			.76		.97
10		1.52					.75		.38			.77		.97
11		2.00					.74		.36			.68		.90
12		2.00					.88		.41			.76		.98
13		1.64					.78		.37			.74		.93
14		1.81					.76		.38			.72		.93
15		1.95					.67		.38			.73		.91

TABLE 3.2 (cont'd.) JULY 1986 (mg/L)

DATE	PRE-CHLORINATION Cl_2 Dem.	PRE-CHLORINATION Cl_2 Dos.	PRE-CHLORINATION NH_3	PRE-CHLORINATION SO_2	PRE-CHLORINATION RESIDUAL Cl_2 Free	PRE-CHLORINATION RESIDUAL Cl_2 Comb.	PRE-CHLORINATION RESIDUAL Cl_2 Total	POST-CHLORINATION Cl_2 Dem.	POST-CHLORINATION Cl_2 Dos.	POST-CHLORINATION NH_3	POST-CHLORINATION SO_2	POST-CHLORINATION RESIDUAL Cl_2 Free	POST-CHLORINATION RESIDUAL Cl_2 Comb.	POST-CHLORINATION RESIDUAL Cl_2 Total
16		1.61					.94		.36			.86		1.02
17		1.62					.81		.35			.83		1.02
18		1.89					.76		.38			.74		.94
19		1.86					.77		.37			.72		.93
20		1.65					.75		.38			.76		.92
21		1.42					.75		.38			.73		.96
22		1.65					.74		.40			.78		1.00
23		1.68					.71		.40			.70		.91
24		2.60					.71		.60			.77		.90
25		2.03					.71		.47			.82		.94
26		2.11					.84		.47			.93		1.06
27		1.94					.78		.38			.80		.98
28		2.08					.80		.36			.80		1.00
29		2.03					.70		.39			.75		.96
30		1.84					.81		.40			.76		.96
31		1.75					.82		.38			.82		1.00

TABLE 3.2: DISINFECTION PROFILE AUGUST 1986 (mg/L)

MOE WPOS PROTOCOL

DATE	PRE-CHLORINATION							POST-CHLORINATION						
	Cl_2		NH_3	SO_2	RESIDUAL Cl_2			Cl_2		NH_3	SO_2	RESIDUAL Cl_2		
	Dem.	Dos.			Free	Comb.	Total	Dem.	Dos.			Free	Comb.	Total
1		1.69					.83		.40			.82		1.02
2		1.78					.83		.37			.80		1.01
3		1.71					.82		.35			.81		1.01
4		1.53					.73		.37			.70		.92
5		2.12					.78		.37			.86		.97
6		1.54					.76		.34			.85		.97
7		1.93					.69		.40			.79		.91
8		1.41					.75		.40			.77		.95
9		1.54					.74		.35			.73		.94
10		1.46					.84		.35			.82		1.03
11		1.96					.72		.34			.75		.94
12		1.69					.78		.48			.84		.98
13		2.02					.83		.41			.91		1.02
14		1.64					.80		.33			.87		1.00
15		2.05					.81		.33			.86		.94

TABLE 3.2 (cont'd.) AUGUST 1986 (mg/L)

DATE	PRE-CHLORINATION							POST-CHLORINATION						
	Cl_2		NH_3	SO_2	RESIDUAL Cl_2			Cl_2		NH_3	SO_2	RESIDUAL Cl_2		
	Dem.	Dos.			Free	Comb.	Total	Dem.	Dos.			Free	Comb.	Total
16		1.71					.84		.33			.88		1.01
17		1.71					.82		.33			.84		.96
18		1.65					.79		.32			.82		.93
19		1.68					.74		.32			.83		.94
20		1.73					.82		.41			.81		.99
21		1.58					.78		.38			.80		.95
22		1.56					.76		.40			.73		.98
23		1.37					.79		.38			.86		.97
24		1.63					.83		.36			.87		.99
25		1.71					.83		.37			.84		.98
26		1.67					.83		.36			.87		1.03
27		1.72					.85		.36			.79		.97
28		1.88					.83		.37			.86		1.02
29		1.80					.77		.43			.86		.95
30		1.53					.76		.43			.81		.93
31							.79		.40			.86		.96

TABLE 3.2: DISINFECTION PROFILE SEPTEMBER 1986 (mg/L)

MOE WPOS PROTOCOL

DATE	PRE-CHLORINATION							POST-CHLORINATION						
	Cl_2		NH_3	SO_2	RESIDUAL Cl_2			Cl_2		NH_3	SO_2	RESIDUAL Cl_2		
	Dem.	Dos.			Free	Comb.	Total	Dem.	Dos.			Free	Comb.	Total
1		1.54					0.80		.40			.84		.99
2		1.72					0.86		.37			.88		1.00
3		1.67					0.74		.36			.82		.99
4		1.69					0.73		.38			.81		.91
5		1.40					0.82		.36			.81		.98
6		2.16					0.79		.35			.81		.99
7		1.76					0.71		.36			.69		.91
8		1.71					0.77		.41			.71		.94
9		2.23					0.79		.42			.85		1.02
10		2.33					0.76		.51			.83		.94
11		1.85					0.84		.38			.93		1.01
12		1.48					0.88		.37			.78		.97
13		1.37					0.82		.28			.72		.94
14		1.48					0.75		.35			.71		.91
15		1.52					0.73		.38			.73		.92

TABLE 3.2 (cont'd.) SEPTEMBER 1986 (mg/L)

DATE	PRE-CHLORINATION							POST-CHLORINATION						
	Cl_2		NH_3	SO_2	RESIDUAL Cl_2			Cl_2		NH_3	SO_2	RESIDUAL Cl_2		
	Dem.	Dos.			Free	Comb.	Total	Dem.	Dos.			Free	Comb.	Total
16		1.80					0.76		.43			.76		.95
17		1.45					0.80		.45			.84		.99
18		1.62					0.76		.38			.75		.93
19		1.84					0.81		.36			.80		.96
20		1.70					0.80		.33			.73		.96
21		1.74					0.79		.34			.74		.94
22		1.98					0.75		.40			.81		.92
23		1.69					0.74		.35			.73		.93
24		1.61					0.73		.36			.85		.97
25		1.83					0.75		.38			.79		.96
26		1.70					0.76		.41			.85		1.00
27		1.70					0.76		.41			.73		.95
28		1.90					0.73		.39			.73		.92
29		1.92					0.78		.43			.80		.99
30		1.30					0.75		.27			.73		.95
31														

TABLE 3.2: DISINFECTION PROFILE OCTOBER 1986 (mg/L)

MOE WPOS PROTOCOL

DATE	PRE-CHLORINATION							POST-CHLORINATION						
	Cl_2		NH_3	SO_2	RESIDUAL Cl_2			Cl_2		NH_3	SO_2	RESIDUAL Cl_2		
	Dem.	Dos.			Free	Comb.	Total	Dem.	Dos.			Free	Comb.	Total
1		1.43					0.80		.39			.76		.97
2		1.51					0.74		.37			.78		1.00
3		1.56					0.79		.39			.70		1.00
4		1.75					0.76		.40			.81		.92
5		1.52					0.76		.36			.82		.91
6		1.54					0.73		.38			.80		.92
7		1.76					0.72		.36			.77		.93
8		1.63					0.91		.30			.89		1.07
9		0.93					0.73		.35			.78		.93
10		1.27					0.71		.33			.71		.91
11		1.29					0.75		.34			.79		.94
12		1.29					0.79		.41			.85		.99
13		1.43					0.77		.39			.75		.94
14		1.28					0.80		.37			.79		.98
15		1.50					0.81		.36			.87		1.03

TABLE 3.2 (cont'd.) OCTOBER 1986 (mg/L)

DATE	PRE-CHLORINATION							POST-CHLORINATION						
	Cl_2		NH_3	SO_2	RESIDUAL Cl_2			Cl_2		NH_3	SO_2	RESIDUAL Cl_2		
	Dem.	Dos.			Free	Comb.	Total	Dem.	Dos.			Free	Comb.	Total
16		1.38					0.75		.30			.86		.94
17		1.47					0.72		.38			.78		.91
18		1.63					0.74		.42			.78		.94
19		1.35					0.78		.43			.81		.97
20		1.45					0.76		.40			.85		.99
21		1.74					0.79		.36			.79		.94
22		1.36					0.79		.30			.83		1.00
23		1.44					0.74		.31			.75		.92
24		1.59					0.72		.37			.72		.90
25		1.69					0.75		.41			.78		.97
26		1.45					0.74		.42			.74		.95
27		1.61					0.82		.38			.81		1.01
28		1.99					0.74		.46			.80		.92
29		1.66					0.79		.41			.89		.99
30		1.71					0.74		.45			.86		.95
31		1.62					0.78		.33			.79		.97

TABLE 3.2: DISINFECTION PROFILE November 1986 (mg/L)

MOE WPOS PROTOCOL

DATE	PRE-CHLORINATION							POST-CHLORINATION						
	Cl_2		NH_3	SO_2	RESIDUAL Cl_2			Cl_2		NH_3	SO_2	RESIDUAL Cl_2		
	Dem.	Dos.			Free	Comb.	Total	Dem.	Dos.			Free	Comb.	Total
1		1.53					0.77		0.38			0.78		0.92
2		1.62					0.79		0.34			0.92		0.99
3		1.99					0.75		0.29			0.74		0.92
4		1.76					0.77		0.31			0.72		0.92
5		1.64					0.78		0.29			0.77		0.95
6		1.43					0.77		0.30			0.73		0.93
7		1.45					0.74		0.31			0.73		0.91
8		1.76					0.76		0.34			0.70		0.90
9		1.40					0.77		0.36			0.73		0.93
10		1.47					0.82		0.33			0.77		0.97
11		1.55					0.70		0.37			0.74		0.92
12		1.51					0.72		0.34			0.77		0.91
13		1.59					0.78		0.34			0.81		0.94
14		1.42					0.75		0.36			0.78		0.98
15		1.27					0.80		0.34			0.79		0.95

TABLE 3.2 (cont'd.) November 1986 (mg/L)

DATE	PRE-CHLORINATION							POST-CHLORINATION						
	Cl_2		NH_3	SO_2	RESIDUAL Cl_2			Cl_2		NH_3	SO_2	RESIDUAL Cl_2		
	Dem.	Dos.			Free	Comb.	Total	Dem.	Dos.			Free	Comb.	Total
16		1.07					0.76		0.37			0.78		0.98
17		1.43					0.78		0.36			0.76		0.94
18		1.48					0.81		0.30			0.89		1.02
19		1.37					0.75		0.30			0.73		0.91
20		1.54					0.80		0.31			0.81		0.99
21		1.44					0.78		0.30			0.71		0.96
22		1.60					0.74		0.34			0.76		0.93
23		1.38					0.77		0.29			0.81		0.94
24		1.34					0.79		0.28			0.85		0.97
25		1.36					0.78		0.29			0.76		0.98
26		1.45					0.73		0.31			0.79		0.90
27		1.19					0.75		0.32			0.74		0.90
28		1.25					0.72		0.34			0.76		0.90
29		1.31					0.76		0.35			0.84		0.94
30		1.25					0.73		0.36			0.78		0.93
31														

TABLE 3.2: DISINFECTION PROFILE December 1986 (mg/L)

MOE WPOS PROTOCOL

DATE	PRE-CHLORINATION Cl_2 Dem.	Cl_2 Dos.	NH_3	SO_2	RESIDUAL Cl_2 Free	Comb.	Total	POST-CHLORINATION Cl_2 Dem.	Cl_2 Dos.	NH_3	SO_2	RESIDUAL Cl_2 Free	Comb.	Total
1		1.05					0.72		0.34			0.72		0.88
2		1.49					0.78		0.31			0.80		1.00
3		1.28					0.69		0.33			0.81		0.89
4		1.27					0.73		0.34			0.85		0.91
5		1.27					0.73		0.34			0.53		0.89
6		1.14					0.73		0.30			0.76		0.91
7		1.05					0.74		0.30			0.74		0.90
8		1.08					0.69		0.34			0.78		0.88
9		1.11					0.77		0.30			0.83		0.92
10		1.31					0.67		0.37			0.78		0.89
11		1.11					0.67		0.29			0.81		0.89
12		1.12					0.75		0.34			0.73		0.92
13		1.07					0.72		0.38			0.81		0.96
14		0.98					0.66		0.38			0.73		0.89
15		1.27					0.69		0.36			0.80		0.89

TABLE 3.2 (cont'd.) December 1986 (mg/L)

DATE	PRE-CHLORINATION Cl_2 Dem.	Cl_2 Dos.	NH_3	SO_2	RESIDUAL Cl_2 Free	Comb.	Total	POST-CHLORINATION Cl_2 Dem.	Cl_2 Dos.	NH_3	SO_2	RESIDUAL Cl_2 Free	Comb.	Total
16		1.17					0.71		0.30			0.84		0.91
17		1.12					0.69		0.32			0.83		0.91
18		1.28					0.67		0.36			0.81		0.90
19		1.23					0.71		0.39			0.79		0.91
20		1.07					0.73		0.39			0.86		0.94
21		0.92					0.68		0.20			0.82		0.89
22		1.33					0.70		0.35			0.80		0.90
23		1.26					0.70		0.34			0.83		0.92
24		1.02					0.72		0.36			0.81		0.92
25		0.98					0.72		0.39			0.76		0.89
26		1.07					0.65		0.42			0.74		0.90
27		1.29					0.70		0.32			0.82		0.91
28		1.20					0.71		0.42			0.79		0.91
29		1.36					0.69		0.37			0.78		0.89
30		1.21					0.76		0.38			0.85		0.96
31		1.20					0.73		0.34			0.84		0.95

TABLE 3.2: DISINFECTION PROFILE JANUARY 1985 (mg/L)

MOE WPOS PROTOCOL

DATE	PRE-CHLORINATION							POST-CHLORINATION						
	Cl_2		NH_3	SO_2	RESIDUAL Cl_2			Cl_2		NH_3	SO_2	RESIDUAL Cl_2		
	Dem.	Dos.			Free	Comb.	Total	Dem.	Dos.			Free	Comb.	Total
1		1.10					.73		.29			.77		.85
2		1.13					.79		.29			.80		.89
3		1.11					.76		.26			.78		.89
4		1.19					.78		.28			.83		.95
5		1.19					.73		.38			.82		.90
6		1.13					.75		.27			.85		.89
7		1.19					.80		.25			.91		1.00
8		1.27					.69		.27			.70		.87
9		1.29					.74		.28			.81		.94
10		1.11					.75		.24			.84		.95
11		1.10					.77		.20			.79		.90
12		0.91					.75		.19			.75		.85
13		0.88					.72		.22			.68		.83
14		1.05					.76		.25			.70		.88
15		0.87					.79		.25			.79		.89

TABLE 3.2 (cont'd.) JANUARY 1985 (mg/L)

DATE	PRE-CHLORINATION							POST-CHLORINATION						
	Cl_2		NH_3	SO_2	RESIDUAL Cl_2			Cl_2		NH_3	SO_2	RESIDUAL Cl_2		
	Dem.	Dos.			Free	Comb.	Total	Dem.	Dos.			Free	Comb.	Total
16		1.27					.73		.26			.73		.86
17		0.84					.69		.25			.75		.82
18		1.24					.71		.28			.70		.84
19		1.11					.72		.24			.80		.85
20		1.26					.73		.27			.81		.91
21		0.99					.73		.25			.78		.88
22		1.08					.76		.25			.77		.87
23		1.11					.75		.25			.73		.89
24		1.00					.74		.25			.70		.85
25		1.05					.72		.27			.76		.86
26		1.01					.78		.22			.86		.92
27		1.11					.75		.20			.65		.80
28		1.03					.73		.19			.76		.80
29		1.05					.74		.19			.69		.81
30		1.41					.68		.24			.71		.80
31		1.20					.73		.25			.76		.82

TABLE 3.2: DISINFECTION PROFILE FEBRUARY 1985 (mg/L)

MOE WPOS PROTOCOL

DATE	PRE-CHLORINATION							POST-CHLORINATION						
	Cl_2		NH_3	SO_2	RESIDUAL Cl_2			Cl_2		NH_3	SO_2	RESIDUAL Cl_2		
	Dem.	Dos.			Free	Comb.	Total	Dem.	Dos.			Free	Comb.	Total
1		1.12					.75		.22			.77		.87
2		1.18					.75		.24			.77		.88
3		1.11					.72		.25			.80		.83
4		1.22					.77		.23			.70		.88
5		1.01					.77		.26			.73		.88
6		1.00					.74		.23			.70		.83
7		1.22					.74		.23			.71		.83
8		1.07					.74		.23			.73		.86
9		1.06					.79		.23			.70		.87
10		1.16					.74		.23			.72		.89
11		1.33					.73		.29			.79		.83
12		1.15					.75		.23			.83		.85
13		1.16					.71		.22			.78		.83
14		1.15					.72		.23			.80		.82
15		1.12					.74		.23			.71		.86

TABLE 3.2 (cont'd.) FEBRUARY 1985 (mg/L)

DATE	PRE-CHLORINATION Cl_2 Dem.	Cl_2 Dos.	NH_3	SO_2	RESIDUAL Cl_2 Free	Comb.	Total	POST-CHLORINATION Cl_2 Dem.	Cl_2 Dos.	NH_3	SO_2	RESIDUAL Cl_2 Free	Comb.	Total
16		1.03					.72		.23			.78		.85
17		1.07					.72		.23			.68		.82
18		1.11					.71		.23			.73		.82
19		1.11					.71		.24			.70		.83
20		0.77					.74		.23			.71		.88
21		1.15					.74		.23			.76		.89
22		1.04					.70		.23			.70		.81
23		1.48					.71		.30			.75		.84
24		1.14					.70		.23			.76		.81
25		1.25					.72		.31			.79		.86
26		1.12					.72		.27			.72		.88
27		1.19					.75		.28			.82		.91
28		1.06					.67		.27			.72		.86
29														
30														
31														

TABLE 3.2: DISINFECTION PROFILE MARCH 1985 (mg/L)

MOE WPOS PROTOCOL

DATE	PRE-CHLORINATION Cl_2 Dem.	PRE-CHLORINATION Cl_2 Dos.	PRE-CHLORINATION NH_3	PRE-CHLORINATION SO_2	PRE-CHLORINATION RESIDUAL Cl_2 Free	PRE-CHLORINATION RESIDUAL Cl_2 Comb.	PRE-CHLORINATION RESIDUAL Cl_2 Total	POST-CHLORINATION Cl_2 Dem.	POST-CHLORINATION Cl_2 Dos.	POST-CHLORINATION NH_3	POST-CHLORINATION SO_2	POST-CHLORINATION RESIDUAL Cl_2 Free	POST-CHLORINATION RESIDUAL Cl_2 Comb.	POST-CHLORINATION RESIDUAL Cl_2 Total
1		1.32					.76		.31			.65		.83
2		1.21					.77		.26			.91		.95
3		1.32					.79		.26			.86		.93
4		0.96					.76		.29			.77		.89
5		1.27					.76		.23			.71		.86
6		1.09					.74		.23			.70		.88
7		1.32					.73		.31			.79		.85
8		1.47					.76		.34			.77		.84
9		1.27					.81		.29			.73		.91
10		1.58					.74		.29			.72		.88
11		1.22					.78		.30			.76		.91
12		1.25					.77		.30			.77		.91
13		1.34					.78		.29			.70		.92
14		1.25					.71		.29			.66		.84
15		1.08					.78		.30			.66		.87

TABLE 3.2 (cont'd.) MARCH 1985 (mg/L)

DATE	PRE-CHLORINATION							POST-CHLORINATION						
	Cl_2		NH_3	SO_2	RESIDUAL Cl_2			Cl_2		NH_3	SO_2	RESIDUAL Cl_2		
	Dem.	Dos.			Free	Comb.	Total	Dem.	Dos.			Free	Comb.	Total
16		1.23					.81		.30			.74		.92
17		1.26					.80		.30			.73		.91
18		1.11					.79		.29			.78		.92
19		1.18					.83		.28			.83		.91
20		1.20					.75		.29			.77		.86
21		1.26					.75		.29			.75		.87
22		1.25					.74		.29			.69		.86
23		1.18					.77		.29			.81		.91
24		1.12					.73		.32			.80		.88
25		1.12					.74		.29			.70		.88
26		1.24					.77		.29			.70		.87
27		1.18					.72		.29			.73		.87
28		1.33					.71		.27			.68		.84
29		1.43					.79		.29			.82		.90
30		1.36					.78		.29			.77		.94
31		1.23					.72		.29			.74		.86

TABLE 3.2: DISINFECTION PROFILE APRIL 1985 (mg/L)

MOE WPOS PROTOCOL

DATE	PRE-CHLORINATION							POST-CHLORINATION						
	Cl_2		NH_3	SO_2	RESIDUAL Cl_2			Cl_2		NH_3	SO_2	RESIDUAL Cl_2		
	Dem.	Dos.			Free	Comb.	Total	Dem.	Dos.			Free	Comb.	Total
1		1.32					.70		.29			.77		.86
2		1.40					.77		.29			.77		.88
3		1.39					.79		.24			.83		.89
4		1.16					.78		.24			.75		.88
5		1.23					.76		.25			.73		.90
6		1.11					.76		.28			.71		.85
7		1.29					.79		.25			.78		.91
8		1.11					.80		.24			.72		.86
9		1.27					.79		.24			.77		.89
10		1.12					.72		.23			.74		.85
11		1.34					.77		.29			.77		.89
12		1.26					.79		.31			.80		.90
13		1.15					.74		.25			.80		.89
14		1.21					.74		.29			.78		.87
15		1.10					.73		.27			.77		.85

TABLE 3.2 (cont'd.) APRIL 1985 (mg/L)

DATE	PRE-CHLORINATION							POST-CHLORINATION						
	Cl_2		NH_3	SO_2	RESIDUAL Cl_2			Cl_2		NH_3	SO_2	RESIDUAL Cl_2		
	Dem.	Dos.			Free	Comb.	Total	Dem.	Dos.			Free	Comb.	Total
16		1.21					.76		.27			.74		.83
17		1.26					.78		.27			.80		.90
18		1.10					.74		.25			.69		.85
19		1.28					.77		.26			.73		.89
20		1.33					.76		.27			.77		.86
21		0.76					.73		.27			.71		.86
22		1.19					.74		.30			.68		.85
23		1.27					.76		.30			.77		.89
24		1.44					.73		.27			.71		.84
25		1.26					.72		.26			.71		.82
26		1.14					.73		.27			–		.83
27		1.16					.74		.27			.73		.83
28		1.21					.78		.31			.66		.81
29		1.20					.76		.27			.70		.87
30		1.35					.76		.27			.68		.83
31														

TABLE 3.2: DISINFECTION PROFILE MAY 1985 (mg/L)

MOE WPOS PROTOCOL

DATE	PRE-CHLORINATION							POST-CHLORINATION						
	Cl_2		NH_3	SO_2	RESIDUAL Cl_2			Cl_2		NH_3	SO_2	RESIDUAL Cl_2		
	Dem.	Dos.			Free	Comb.	Total	Dem.	Dos.			Free	Comb.	Total
1		1.14					.76		.27			.71		.87
2		1.18					.73		.29			.70		.85
3		1.27					.77		.27			.71		.86
4		1.20					.75		.27			.66		.81
5		1.30					.80		.27			.68		.84
6		1.25					.77		.27			.71		.88
7		1.13					.72		.24			.72		.80
8		1.19					.74		.26			.70		.83
9		1.24					.74		.27			.62		.82
10		1.28					.76		.31			.59		.90
11		1.19					.72		.28			.74		.82
12		1.28					.72		.28			.69		.82
13		1.09					.71		.30			.66		.81
14		1.37					.74		.31			.69		.84
15		1.07					.74		.31			.70		.86

TABLE 3.2 (cont'd.) MAY 1985 (mg/L)

DATE	PRE-CHLORINATION							POST-CHLORINATION						
	Cl_2		NH_3	SO_2	RESIDUAL Cl_2			Cl_2		NH_3	SO_2	RESIDUAL Cl_2		
	Dem.	Dos.			Free	Comb.	Total	Dem.	Dos.			Free	Comb.	Total
16		1.23					.74		.32			.64		.83
17		1.16					.76		.32			.63		.81
18		1.77					.70		.42			.70		.81
19		1.24					.75		.30			.71		.84
20		1.29					.75		.34			.71		.82
21		1.32					.76		.31			.77		.89
22		1.23					.71		.31			.68		.84
23		1.25					.73		.31			.60		.82
24		1.35					.72		.29			.65		.81
25		1.17					.69		.34			.54		.69
26		1.35					.75		.39			.86		.88
27		1.35					.75		.40			.71		.91
28		1.35					.74		.40			.82		.90
29		1.33					.78		.38			.73		.93
30		1.34					.78		.39			.85		.93
31		1.38					.81		.28			.77		.88

TABLE 3.2: DISINFECTION PROFILE JUNE 1985 (mg/L)

MOE WPOS PROTOCOL

DATE	PRE-CHLORINATION Cl_2 Dem.	PRE-CHLORINATION Cl_2 Dos.	PRE-CHLORINATION NH_3	PRE-CHLORINATION SO_2	PRE-CHLORINATION RESIDUAL Cl_2 Free	PRE-CHLORINATION RESIDUAL Cl_2 Comb.	PRE-CHLORINATION RESIDUAL Cl_2 Total	POST-CHLORINATION Cl_2 Dem.	POST-CHLORINATION Cl_2 Dos.	POST-CHLORINATION NH_3	POST-CHLORINATION SO_2	POST-CHLORINATION RESIDUAL Cl_2 Free	POST-CHLORINATION RESIDUAL Cl_2 Comb.	POST-CHLORINATION RESIDUAL Cl_2 Total
1		1.28					.84		.28			.71		.93
2		1.28					.77		.23			.71		.85
3		1.24					.71		.26			.62		.80
4		1.43					.76		.32			.69		.88
5		1.32					.72		.35			.70		.88
6		1.35					.77		.35			.76		.91
7		1.52					.75		.35			.76		.92
8		1.28					.74		.32			.66		.84
9		1.45					.78		.34			.72		.90
10		1.45					.77		.34			.77		.92
11		1.27					.73		.36			.69		.86
12		1.28					.71		.36			.58		.82
13		1.34					.75		.35			.68		.86
14		1.57					.69		.34			.68		.82
15		1.48					.76		.36			.70		.87

TABLE 3.2 (cont'd.) JUNE 1985 (mg/L)

DATE	PRE-CHLORINATION							POST-CHLORINATION						
	Cl_2		NH_3	SO_2	RESIDUAL Cl_2			Cl_2		NH_3	SO_2	RESIDUAL Cl_2		
	Dem.	Dos.			Free	Comb.	Total	Dem.	Dos.			Free	Comb.	Total
16		1.44					.76		.36			.72		.91
17		1.19					.75		.32			.73		.90
18		1.30					.76		.31			.68		.83
19		1.47					.76		.28			.69		.87
20		1.66					.70		.33			.69		.84
21		1.38					.65		.34			.58		.81
22		1.75					.72		.39			.60		.83
23		1.54					.83		.33			.86		.98
24		1.60					.83		.35			.77		.90
25		1.78					.79		.35			.80		.92
26		1.66					.80		.34			.68		.94
27		1.58					.77		.35			.76		.90
28		1.58					.80		.35			.69		.96
29		1.71					.78		.38			.73		.91
30		1.63					.80		.43			.73		.90
31														

TABLE 3.2: DISINFECTION PROFILE JULY 1985 (mg/L)

MOE WPOS PROTOCOL

DATE	PRE-CHLORINATION							POST-CHLORINATION						
	Cl_2		NH_3	SO_2	RESIDUAL Cl_2			Cl_2		NH_3	SO_2	RESIDUAL Cl_2		
	Dem.	Dos.			Free	Comb.	Total	Dem.	Dos.			Free	Comb.	Total
1		1.51					.84		.41			.76		
2		1.83					.77		.36			.77		
3		1.52					.72		.39			.66		
4		1.53					.70		.39			.65		
5		1.65					.76		.40			.75		
6		1.79					.79		.43			.85		
7		1.62					.75		.47			.82		
8		1.53					.74		.41			.63		
9		1.88					.71		.41			.76		
10		1.52					.84		.43			.77		
11		1.29					.70		.57			.75		
12		1.56					.69		.46			.77		
13		1.73					.73		.49			.75		
14		1.63					.81		.50			.81		
15		1.57					.87		.51			.84		

TABLE 3.2 (cont'd.) JULY 1985 (mg/L)

DATE	PRE-CHLORINATION							POST-CHLORINATION						
	Cl_2		NH_3	SO_2	RESIDUAL Cl_2			Cl_2		NH_3	SO_2	RESIDUAL Cl_2		
	Dem.	Dos.			Free	Comb.	Total	Dem.	Dos.			Free	Comb.	Total
16		1.60					.81		.46			.70		
17		1.79					.73		.47			.78		
18		1.74					.72		.46			.72		
19		1.59					.81		.42			.75		
20		1.60					.73		.35			.78		
21		1.69					.67		.43			.69		
22		1.85					.74		.47			.81		
23		1.97					.74		.50			.75		
24		1.93					.73		.50			.80		
25		1.70					.83		.49			.81		
26		1.58					.88		.38			.87		
27		1.66					.74		.32			.70		
28		1.76					.76		.35			.66		
29		1.75					.72		.37			.70		
30		1.81					.76		.41			.77		
31		1.64					.80		.40			.81		

TABLE 3.2: DISINFECTION PROFILE AUGUST 1985 (mg/L)

MOE WPOS PROTOCOL

DATE	PRE-CHLORINATION							POST-CHLORINATION						
	Cl_2		NH_3	SO_2	RESIDUAL Cl_2			Cl_2		NH_3	SO_2	RESIDUAL Cl_2		
	Dem.	Dos.			Free	Comb.	Total	Dem.	Dos.			Free	Comb.	Total
1		1.55					.81		.35			.76		.90
2		1.67					.84		.38			.77		.96
3		1.64					.79		.35			.73		.96
4		1.52					.75		.36			.66		.91
5		1.46					.78		.36			.70		.90
6		1.48					.79		.37			.80		.92
7		1.52					.82		.38			.75		.96
8		1.78					.69		.42			.66		.87
9		1.84					.70		.56			.71		.90
10		1.74					.79		.58			.85		.98
11		1.93					.76		.57			.90		.98
12		1.89					.73		.60			.83		.93
13		1.96					.82		.51			.99		1.10
14		1.95					.79		.41			.87		.98
15		1.87					.76		.42			.86		.95

DATE	PRE-CHLORINATION							POST-CHLORINATION						
	Cl_2		NH_3	SO_2	RESIDUAL Cl_2			Cl_2		NH_3	SO_2	RESIDUAL Cl_2		
	Dem.	Dos.			Free	Comb.	Total	Dem.	Dos.			Free	Comb.	Total
16		1.81					.74		.43			.75		.93
17		1.73					.80		.47			.81		.97
18		1.79					.79		.44			.83		.98
19		1.54					.82		.42			.81		.97
20		1.86					.60		.48			.71		.88
21		2.40					.71		.61			.81		.95
22		3.00					.70		.70			.82		.93
23		3.20					.69		.47			.81		.92
24		3.10					.76		.46			.73		.89
25		2.15					1.00		.30			1.04		1.20
26		1.73					.76		.28			.72		.88
27		1.77					.75		.32			.71		.86
28		1.67					.73		.28			.70		.86
29		1.68					.73		.42			.76		.88
30		1.72					.76		.42			.75		.92
31		1.68					.72		.43			.76		.90

TABLE 3.2: DISINFECTION PROFILE SEPTEMBER 1985 (mg/L)

MOE WPOS PROTOCOL

DATE	PRE-CHLORINATION							POST-CHLORINATION						
	Cl_2		NH_3	SO_2	RESIDUAL Cl_2			Cl_2		NH_3	SO_2	RESIDUAL Cl_2		
	Dem.	Dos.			Free	Comb.	Total	Dem.	Dos.			Free	Comb.	Total
1		1.56					.77		.43			.71		.90
2		1.76					.88		.44			.79		.98
3		1.62					.79		.34			.83		.90
4		1.64					.78		.36			.78		.89
5		1.72					.68		.37			.76		.92
6		1.66					.83		.35			.87		1.05
7		1.28					.78		.42			.84		.98
8		1.40					.79		.39			.76		.92
9		0.99					.79		.41			.81		1.00
10		1.78					.72		.54			.79		.97
11		1.73					.74		.51			.82		.98
12		1.59					.76		.46			.86		1.01
13		1.71					.75		.48			.75		.92
14		1.65					.79		.44			.73		.94
15		1.95					.78		.58			.88		.97

TABLE 3.2 (cont'd.) SEPTEMBER 1985 (mg/L)

DATE	PRE-CHLORINATION							POST-CHLORINATION						
	Cl_2		NH_3	SO_2	RESIDUAL Cl_2			Cl_2		NH_3	SO_2	RESIDUAL Cl_2		
	Dem.	Dos.			Free	Comb.	Total	Dem.	Dos.			Free	Comb.	Total
16		1.78					.81		.37			.93		.99
17		1.84					.79		.47			.90		1.00
18		1.81					.73		.41			.78		.93
19		1.86					.79		.41			.73		.92
20		1.69					.75		.41			.73		.97
21		1.57					.75		.40			.82		.96
22		1.73					.75		.52			.80		.95
23		1.71					.79		.52			.84		1.03
24		1.75					.78		.54			.85		1.02
25		1.92					.94		.46			.92		1.08
26		1.18					.92		.40			.75		.92
27		1.76					.76		.38			.82		.93
28		1.56					.77		.45			.89		.98
29		1.65					.77		.49			.88		.96
30		1.65					.78		.44			.84		.97
31														

TABLE 3.2: DISINFECTION PROFILE OCTOBER 1985 (mg/L)

MOE WPOS PROTOCOL

DATE	PRE-CHLORINATION							POST-CHLORINATION						
	Cl_2		NH_3	SO_2	RESIDUAL Cl_2			Cl_2		NH_3	SO_2	RESIDUAL Cl_2		
	Dem.	Dos.			Free	Comb.	Total	Dem.	Dos.			Free	Comb.	Total
1		1.58					.78		.44			.96		1.02
2		1.59					.79		.41			.77		.93
3		1.56					.75		.42			.81		.94
4		1.50					.74		.41			.85		.96
5		1.56					.77		.42			.79		.92
6		1.17					.79		.42			.81		1.00
7		1.34					.72		.42			.75		.92
8		1.56					.80		.40			.81		.99
9		1.35					.78		.39			.79		.97
10		1.56					.80		.41			.89		.97
11		1.54					.77		.42			.80		.98
12		2.00					.73		.44			.68		.93
13		1.52					.81		.49			.90		.99
14		1.53					.77		.49			.91		.99
15		1.48					.75		.49			.74		.98

TABLE 3.2 (cont'd.) OCTOBER 1985 (mg/L)

DATE	PRE-CHLORINATION							POST-CHLORINATION						
	Cl_2		NH_3	SO_2	RESIDUAL Cl_2			Cl_2		NH_3	SO_2	RESIDUAL Cl_2		
	Dem.	Dos.			Free	Comb.	Total	Dem.	Dos.			Free	Comb.	Total
16		1.54					.75		.45			.82		.99
17		1.49					.73		.47			.79		.98
18		1.21					.76		.48			.77		.94
19		1.62					.78		.46			.83		1.00
20		1.30					.77		.48			.83		1.00
21		1.53					.74		.50			.81		.92
22		1.53					.77		.48			.90		.98
23		1.41					.75		.45			.84		.96
24		1.65					.76		.47			.78		.97
25		1.46					.79		.46			.82		1.00
26		1.40					.78		.47			.76		.98
27		1.26					.73		.48			.84		.94
28		1.49					.71		.48			.80		.93
29		1.51					.77		.46			.83		.97
30		1.65					.78		.47			.83		1.00
31		1.72					.73		.43			.78		.97

TABLE 3.2: DISINFECTION PROFILE NOVEMBER 1985 (mg/L)

MOE WPOS PROTOCOL

DATE	PRE-CHLORINATION Cl_2 Dem.	Dos.	NH_3	SO_2	RESIDUAL Cl_2 Free	Comb.	Total	POST-CHLORINATION Cl_2 Dem.	Dos.	NH_3	SO_2	RESIDUAL Cl_2 Free	Comb.	Total
1		1.48					.75		.42			.63		.91
2		1.47					.83		.41			.80		1.03
3		1.47					.82		.42			.78		1.00
4		1.46					.83		.41			.80		1.00
5		1.41					.76		.43			.75		1.00
6		1.54					.75		.42			.89		.98
7		1.45					.73		.43			.76		.91
8		1.45					.76		.45			.72		.94
9		1.40					.74		.45			.77		.94
10		1.27					.78		.53			.82		.93
11		1.27					.77		.47			.81		.99
12		1.37					.80		.43			.88		1.02
13		1.42					.77		.44			.78		.97
14		1.64					.76		.46			.80		.99
15		1.38					.73		.45			.78		.95

DATE	PRE-CHLORINATION Cl_2 Dem.	Dos.	NH_3	SO_2	RESIDUAL Cl_2 Free	Comb.	Total	POST-CHLORINATION Cl_2 Dem.	Dos.	NH_3	SO_2	RESIDUAL Cl_2 Free	Comb.	Total
16		1.36					.76		.43			.78		.97
17		1.54					.78		.44			.81		.96
18		1.29					.75		.44			.76		.95
19		1.34					.81		.44			.79		1.01
20		1.25					.76		.44			.82		.97
21		1.27					.72		.39			.82		.95
22		1.39					.76		.37			.76		.91
23		1.21					.80		.34			.78		.95
24		1.27					.77		.33			.70		.90
25		1.64					.76		.32			.69		.87
26		1.34					.73		.40			.77		.88
27		1.39					.75		.45			.84		.94
28		1.40					.77		.38			.85		.96
29		1.30					.76		.37			.78		.94
30		1.25					.75		.38			.79		.92
31														

TABLE 3.2: DISINFECTION PROFILE DECEMBER 1985 (mg/L)

MOE WPOS PROTOCOL

DATE	PRE-CHLORINATION							POST-CHLORINATION						
	Cl_2		NH_3	SO_2	RESIDUAL Cl_2			Cl_2		NH_3	SO_2	RESIDUAL Cl_2		
	Dem.	Dos.			Free	Comb.	Total	Dem.	Dos.			Free	Comb.	Total
1		1.56					.78		.39			.79		.91
2		1.39					.79		.37			.81		.97
3		1.28					.79		.33			.87		.97
4		1.22					.78		.29			.80		.92
5		1.28					.71		.29			.77		.93
6		1.18					.77		.31			.73		.89
7		1.27					.73		.34			.75		.91
8		1.50					.77		.39			.79		.89
9		1.36					.76		.33			.82		.93
10		1.30					.73		.33			.77		.88
11		1.29					.75		.34			.76		.89
12		1.34					.77		.33			.78		.95
13		1.33					.71		.34			.75		.92
14		1.23					.80		.35			.80		.92
15		1.21					.81		.35			.76		.88

TABLE 3.2 (cont'd.) DECEMBER 1985 (mg/L)

DATE	PRE-CHLORINATION Cl_2 Dem.	PRE-CHLORINATION Cl_2 Dos.	PRE-CHLORINATION NH_3	PRE-CHLORINATION SO_2	PRE-CHLORINATION RESIDUAL Cl_2 Free	PRE-CHLORINATION RESIDUAL Cl_2 Comb.	PRE-CHLORINATION RESIDUAL Cl_2 Total	POST-CHLORINATION Cl_2 Dem.	POST-CHLORINATION Cl_2 Dos.	POST-CHLORINATION NH_3	POST-CHLORINATION SO_2	POST-CHLORINATION RESIDUAL Cl_2 Free	POST-CHLORINATION RESIDUAL Cl_2 Comb.	POST-CHLORINATION RESIDUAL Cl_2 Total
16		1.23					.81		.33			.81		.98
17		1.04					.74		.31			.74		.91
18		1.20					.71		.31			.70		.88
19		1.11					.76		.32			.76		.89
20		1.34					.70		.36			.79		.87
21		1.26					.74		.36			.83		.90
22		1.13					.74		.37			.82		.88
23		1.33					.81		.33			.79		.94
24		1.24					.78		.31			.83		.92
25		1.13					.72		.30			.76		.88
26		1.06					.76		.35			.75		.89
27		1.14					.71		.32			.74		.87
28		1.04					.71		.36			.73		.91
29		0.93					.77		.43			.72		.90
30		1.13					.72		.34			.79		.90
31		1.28					.64		.36			.67		.81

TABLE 3.2: DISINFECTION PROFILE JANUARY 1984 (mg/L)

MOE WPOS PROTOCOL

DATE	PRE-CHLORINATION							POST-CHLORINATION						
	Cl_2		NH_3	SO_2	RESIDUAL Cl_2			Cl_2		NH_3	SO_2	RESIDUAL Cl_2		
	Dem.	Dos.			Free	Comb.	Total	Dem.	Dos.			Free	Comb.	Total
1		1.02					.72		.27			.78		.91
2		1.23					.72		.34			.77		.94
3		1.02					.68		.33			.71		.88
4		1.12					.77		.36			.84		.99
5		1.27					.71		.34			.71		.99
6		1.21					.69		.34			.78		.94
7		1.17					.70		.34			.78		.94
8		1.24					.72		.31			.78		.95
9		1.17					.75		.34			.83		1.00
10		1.30					.73		.36			.81		.97
11		1.24					.73		.35			.82		.99
12		1.18					.71		.36			.81		.96
13		1.24					.73		.35			.84		.96
14		1.28					.79		.28			.82		1.03
15		2.51					.78		.27			.80		.95

TABLE 3.2 (cont'd.) JANUARY 1984 (mg/L)

DATE	PRE-CHLORINATION							POST-CHLORINATION						
	Cl_2		NH_3	SO_2	RESIDUAL Cl_2			Cl_2		NH_3	SO_2	RESIDUAL Cl_2		
	Dem.	Dos.			Free	Comb.	Total	Dem.	Dos.			Free	Comb.	Total
16		1.41					.72		.28			.83		.98
17		1.03					.71		.32			.70		.89
18		1.22					.74		.32			.84		.96
19		1.27					.70		.35			.78		.94
20		1.39					.75		.38			.90		.99
21		1.20					.69		.33			.88		.95
22		1.28					.65		.34			.72		.91
23		1.32					.71		.40			.82		.96
24		1.32					.72		.35			.89		1.01
25		1.26					.76		.29			.85		1.01
26		1.33					.70		.30			.86		.94
27		1.25					.67		.31			.80		.91
28		1.41					.64		.32			.78		.89
29		1.32					.73		.33			.82		.93
30		1.60					.79		.34			.87		1.01
31		1.46					.77		.31			.84		.97

TABLE 3.2: DISINFECTION PROFILE FEBRUARY 1984 (mg/L)

MOE WPOS PROTOCOL

DATE	PRE-CHLORINATION							POST-CHLORINATION						
	Cl_2		NH_3	SO_2	RESIDUAL Cl_2			Cl_2		NH_3	SO_2	RESIDUAL Cl_2		
	Dem.	Dos.			Free	Comb.	Total	Dem.	Dos.			Free	Comb.	Total
1		1.35					.66		.31			.79		.93
2		1.39					.68		.34			.75		.90
3		1.33					.68		.34			.71		.96
4		1.68					.67		.34			.80		.93
5		1.50					.69		.34			.77		.92
6		1.54					.74		.34			.79		.98
7		1.60					.74		.34			.91		1.01
8		1.43					.69		.34			.79		.95
9		1.57					.71		.35			.86		.98
10		1.47					.71		.35			.81		.95
11		1.57					.76		.35			.91		.99
12		1.33					.75		.34			.85		.98
13		1.53					.77		.36			.85		.99
14		1.70					.77		.31			1.01		1.02
15		1.56					.83		.31			.77		1.02

DATE	PRE-CHLORINATION Cl_2 Dem.	Cl_2 Dos.	NH_3	SO_2	RESIDUAL Cl_2 Free	Comb.	Total	POST-CHLORINATION Cl_2 Dem.	Cl_2 Dos.	NH_3	SO_2	RESIDUAL Cl_2 Free	Comb.	Total
16		1.38					.85		.30			1.01		1.05
17		1.39					.68		.31			.88		.90
18		1.68					.68		.36			.93		.94
19		1.51					.84		.30			.98		1.03
20		1.28					.80		.25			.85		.96
21		1.54					.80		.25			.88		.99
22		1.23					.74		.25			.85		.94
23		1.40					.69		.25			.74		.89
24		1.56					.77		.26			.83		.92
25		1.31					.81		.23			.80		.95
26		1.68					.83		.25			.85		.96
27		1.44					.83		.26			.82		.98
28		1.32					.76		.40			.84		.91
29		1.24					.89		.26			.92		.99
30														
31														

TABLE 3.2: DISINFECTION PROFILE MARCH 1984 (mg/L)

MOE WPOS PROTOCOL

DATE	PRE-CHLORINATION							POST-CHLORINATION						
	Cl_2		NH_3	SO_2	RESIDUAL Cl_2			Cl_2		NH_3	SO_2	RESIDUAL Cl_2		
	Dem.	Dos.			Free	Comb.	Total	Dem.	Dos.			Free	Comb.	Total
1		1.50					.80		.25			.82		.98
2		1.23					.78		.25			.79		.95
3		1.37					.80		.26			.87		.96
4		1.24					.73		.25			.79		.93
5		1.29					.72		.25			.76		.90
6		1.32					.67		.28			.69		.84
7		1.39					.78		.31			.90		.93
8		1.34					.82		.32			.88		1.00
9		1.28					.77		.31			.82		.96
10		1.23					.78		.31			.84		.96
11		1.23					.75		.31			.82		.92
12		1.24					.75		.32			.84		.97
13		1.19					.68		.31			.88		.89
14		1.44					.74		.31			.88		.91
15		1.20					.82		.31			.95		.99

TABLE 3.2 (cont'd.) MARCH 1984 (mg/L)

DATE	PRE-CHLORINATION							POST-CHLORINATION						
	Cl_2		NH_3	SO_2	RESIDUAL Cl_2			Cl_2		NH_3	SO_2	RESIDUAL Cl_2		
	Dem.	Dos.			Free	Comb.	Total	Dem.	Dos.			Free	Comb.	Total
16		1.40					.73		.31			.87		.92
17		1.37					.71		.30			.81		.90
18		1.17					.79		.31			.79		.94
19		1.01					.78		.30			.91		.99
20		1.38					.85		.31			.82		.94
21		1.03					.87		.25			.31		1.13
22		1.61					.94		.32			.17		.92
23		1.08					.76		.30			.28		.98
24		1.43					.82		.38			.13		.87
25		1.50					.87		.34			.90		1.05
26		1.76					.67		.34			.84		.96
27		2.90					1.35		.40			.72		1.00
28		1.08					.81		.37			.18		.91
29		1.54					.74		.46			.59		.88
30		2.02					.81		.31			.81		.97
31		2.02					.70		.31			.68		.90

TABLE 3.2: DISINFECTION PROFILE APRIL 1984 (mg/L)

MOE WPOS PROTOCOL

DATE	PRE-CHLORINATION Cl_2 Dem.	Cl_2 Dos.	NH_3	SO_2	RESIDUAL Cl_2 Free	Comb.	Total	POST-CHLORINATION Cl_2 Dem.	Cl_2 Dos.	NH_3	SO_2	RESIDUAL Cl_2 Free	Comb.	Total
1		2.33					.73		.34			.83		.91
2		2.00					.79		.34			.74		.93
3		1.89					.91		.31			1.01		1.10
4		1.77					.76		.25			.69		.89
5		1.75					.83		.26			.78		.97
6		1.59					.78		.26			.66		.89
7		1.69					.81		.26			.85		.98
8		1.69					.80		.26			.78		.96
9		1.59					.84		.25			.81		.95
10		1.65					.72		.25			.76		.90
11		1.41					.86		.23			.76		.95
12		1.63					.93		.20			.78		.93
13		1.56					.76		.21			.71		.85
14		1.48					.77		.22			.89		.91
15		1.24					.80		.20			.89		.95

TABLE 3.2 (cont'd.) APRIL 1984 (mg/L)

DATE	PRE-CHLORINATION							POST-CHLORINATION						
	Cl_2		NH_3	SO_2	RESIDUAL Cl_2			Cl_2		NH_3	SO_2	RESIDUAL Cl_2		
	Dem.	Dos.			Free	Comb.	Total	Dem.	Dos.			Free	Comb.	Total
16		1.76					.70		.20			.79		.90
17		1.46					.87		.20			.63		.92
18		1.58					.78		.18			.77		.96
19		1.43					.77		.19			.76		.89
20		1.39					.76		.20			.72		.91
21		1.42					.81		.17			–		.94
22		1.59					.75		.18			.71		.92
23		1.42					.92		.17			.86		.98
24		1.28					.79		.18			.84		.98
25		1.12					.75		.20			.82		.89
26		1.26					.78		.24			.88		.96
27		1.14					.73		.23			.85		.93
28		1.23					.74		.24			.86		.93
29		1.17					.72		.24			.83		.91
30		1.43					.72		.24			.80		.90
31														

TABLE 3.2: DISINFECTION PROFILE MAY 1984 (mg/L)

MOE WPOS PROTOCOL

DATE	PRE-CHLORINATION							POST-CHLORINATION						
	Cl_2		NH_3	SO_2	RESIDUAL Cl_2			Cl_2		NH_3	SO_2	RESIDUAL Cl_2		
	Dem.	Dos.			Free	Comb.	Total	Dem.	Dos.			Free	Comb.	Total
1		1.15					.80		.22			.79		.95
2		1.38					.72		.23			.75		.92
3		1.37					.70		.27			.69		.89
4		1.38					.73		.26			.75		.94
5		1.27					.79		.26			.79		.93
6		1.51					.80		.24			.83		.99
7		1.48					.72		.26			.81		.92
8		1.35					.74		.32			.72		.90
9		1.37					.72		.42			.74		.91
10		1.18					.79		.40			.81		.97
11		1.22					.73		.40			.74		.92
12		1.37					.75		.41			.81		.94
13		1.23					.74		.40			.74		.92
14		1.77					.74		.42			.79		.95
15		1.29					.73		.41			.80		.90

TABLE 3.2 (cont'd.) MAY 1984 (mg/L)

DATE	PRE-CHLORINATION							POST-CHLORINATION						
	Cl_2		NH_3	SO_2	RESIDUAL Cl_2			Cl_2		NH_3	SO_2	RESIDUAL Cl_2		
	Dem.	Dos.			Free	Comb.	Total	Dem.	Dos.			Free	Comb.	Total
16		1.46					.78		.42			.85		.96
17		1.36					.80		.32			.88		.97
18		1.42					.79		.41			.78		.98
19		1.25					.81		.42			.89		.98
20		1.50					.82		.41			.94		1.06
21		1.31					.81		.32			.84		.99
22		1.32					.82		.41			.80		1.00
23		1.42					.76		.39			.77		.93
24		1.37					.72		.41			.86		.93
25		1.18					.77		.41			.83		.93
26		1.45					.80		.42			.87		.98
27		1.39					.78		.42			.82		.95
28		1.47					.82		.42			.71		1.02
29		1.31					.82		.41			.85		1.03
30		1.24					.76		.42			.79		.97
31		1.28					.76		.41			.76		.94

TABLE 3.2: DISINFECTION PROFILE JUNE 1984 (mg/L)

MOE WPOS PROTOCOL

DATE	PRE-CHLORINATION							POST-CHLORINATION						
	Cl_2		NH_3	SO_2	RESIDUAL Cl_2			Cl_2		NH_3	SO_2	RESIDUAL Cl_2		
	Dem.	Dos.			Free	Comb.	Total	Dem.	Dos.			Free	Comb.	Total
1		1.27					0.73		.41			.74		.93
2		1.20					0.71		.41			.76		.91
3		1.60					0.66		.44			.70		.90
4		1.29					0.70		.49			.69		.95
5		1.30					0.65		.49			.70		.93
6		1.58					0.73		.41			.72		.93
7		1.38					0.70		.41			.79		.96
8		1.64					0.73		.46			.75		.94
9		1.76					0.78		.40			.74		.92
10		1.46					0.77		.38			.76		.94
11		2.01					0.84		.38			.81		1.01
12		1.78					0.79		.39			.89		.99
13		1.53					0.76		.38			.87		1.00
14		1.96					0.75		.48			.33		.96
15		1.60					0.79		.40			.80		.93

TABLE 3.2 (cont'd.) JUNE 1984 (mg/L)

DATE	PRE-CHLORINATION							POST-CHLORINATION						
	Cl_2		NH_3	SO_2	RESIDUAL Cl_2			Cl_2		NH_3	SO_2	RESIDUAL Cl_2		
	Dem.	Dos.			Free	Comb.	Total	Dem.	Dos.			Free	Comb.	Total
16		1.57					0.73		.38			.81		.93
17		1.59					0.75		.40			.80		.93
18		1.48					0.86		.39			.86		1.01
19		1.59					0.86		.35			.83		1.06
20		1.62					0.83		.37			.83		1.03
21		1.25					0.78		.36			.68		.95
22		1.51					0.73		.30			.70		.90
23		1.55					0.83		.43			.76		.95
24		1.51					0.75		.40			–		.87
25		1.22					0.77		.41			.77		.94
26		1.69					0.74		.37			.86		.93
27		1.56					0.80		.35			.73		.94
28		1.56					0.76		.41			.79		.98
29		1.54					0.74		.40			.83		1.00
30		1.53					0.73		.49			.73		.93
31														

TABLE 3.2: DISINFECTION PROFILE JULY 1984 (mg/L)

MOE WPOS PROTOCOL

DATE	PRE-CHLORINATION							POST-CHLORINATION						
	Cl_2		NH_3	SO_2	RESIDUAL Cl_2			Cl_2		NH_3	SO_2	RESIDUAL Cl_2		
	Dem.	Dos.			Free	Comb.	Total	Dem.	Dos.			Free	Comb.	Total
1		1.62					0.72		.43			.83		.95
2		1.50					0.70		.50			.71		.91
3		1.64					0.71		.53			.82		.99
4		1.68					0.74		.51			.75		.94
5		1.86					0.81		.51			.97		1.05
6		1.67					0.82		.52			.86		1.05
7		1.67					0.75		.51			.84		.95
8		1.68					0.75		.52			.86		.97
9		1.53					0.77		.52			.80		.99
10		1.72					0.71		.54			.85		.96
11		1.61					0.81		.42			.84		1.00
12		1.45					0.73		.37			.82		.96
13		1.57					0.74		.45			.85		.94
14		1.56					0.74		.49			.80		.92
15		1.51					0.75		.45			.79		.94

DATE	PRE-CHLORINATION							POST-CHLORINATION						
	Cl_2		NH_3	SO_2	RESIDUAL Cl_2			Cl_2		NH_3	SO_2	RESIDUAL Cl_2		
	Dem.	Dos.			Free	Comb.	Total	Dem.	Dos.			Free	Comb.	Total
16		1.45					0.70		.37			.76		.95
17		1.50					0.77		.36			.78		.98
18		1.66					0.75		.39			.76		.98
19		1.35					0.80		.41			.80		1.01
20		1.42					0.75		.48			.71		.94
21		1.34					0.73		.49			.71		.94
22		1.46					0.75		.47			.75		.96
23		1.66					0.77		.60			.75		.96
24		1.54					0.70		.36			.79		.95
25		1.49					0.69		.48			.79		.95
26		1.61					0.68		.44			.72		.90
27		1.53					0.67		.46			.77		.94
28		1.74					0.77		.47			.73		.93
29		1.56					0.77		.47			.76		.94
30		1.66					0.81		.42			.82		1.00
31		1.50					0.83		.45			.87		1.03

TABLE 3.2: DISINFECTION PROFILE AUGUST 1984 (mg/L)

MOE WPOS PROTOCOL

DATE	PRE-CHLORINATION							POST-CHLORINATION						
	Cl_2		NH_3	SO_2	RESIDUAL Cl_2			Cl_2		NH_3	SO_2	RESIDUAL Cl_2		
	Dem.	Dos.			Free	Comb.	Total	Dem.	Dos.			Free	Comb.	Total
1		1.62					0.79		.41			.80		1.00
2		1.82					0.84		.43			.84		1.03
3		1.26					0.78		.38			.81		1.01
4		1.39					0.78		.39			.74		.93
5		1.35					0.84		.40			.75		.94
6		1.28					0.80		.44			.81		.97
7		1.39					0.73		.50			.75		.94
8		1.52					0.72		.42			.75		.94
9		1.20					0.70		.42			.71		.91
10		1.43					0.73		.32			.85		.95
11		1.69					0.66		.46			.80		.93
12		1.42					0.81		.51			.85		1.01
13		1.36					0.79		.46			.86		1.06
14		1.15					0.74		.44			.80		.97
15		1.54					0.67		.46			.79		.93

TABLE 3.2 (cont'd.) AUGUST 1984 (mg/L)

DATE	PRE-CHLORINATION							POST-CHLORINATION						
	Cl_2		NH_3	SO_2	RESIDUAL Cl_2			Cl_2		NH_3	SO_2	RESIDUAL Cl_2		
	Dem.	Dos.			Free	Comb.	Total	Dem.	Dos.			Free	Comb.	Total
16		1.24					0.63		.55			.78		.92
17		1.65					0.71		.54			.75		.96
18		1.74					0.77		.46			.82		1.03
19		1.95					0.77		.60			.82		.98
20		1.62					0.74		.45			.78		.93
21		1.69					0.79		.36			.85		1.03
22		2.06					0.84		.42			.78		.97
23		1.68					0.74		.35			.96		.98
24		1.70					0.76		.38			.75		.91
25		1.71					0.80		.39			.80		.98
26		1.72					0.83		.40			.81		.97
27		1.76					0.91		.39			.84		1.00
28		1.51					0.79		.51			.81		1.01
29		1.69					0.73		.30			–		.99
30		1.64					0.73		.37			.72		.91
31		1.64					0.76		.42			.72		.93

TABLE 3.2: DISINFECTION PROFILE SEPTEMBER 1984 (mg/L)

MOE WPOS PROTOCOL

DATE	PRE-CHLORINATION							POST-CHLORINATION						
	Cl_2		NH_3	SO_2	RESIDUAL Cl_2			Cl_2		NH_3	SO_2	RESIDUAL Cl_2		
	Dem.	Dos.			Free	Comb.	Total	Dem.	Dos.			Free	Comb.	Total
1		1.72					0.73		.47			.71		.93
2		1.81					0.70		.53			.85		.95
3		1.65					0.73		.44			.79		.98
4		1.64					0.76		.42			.96		1.00
5		1.75					0.73		.42			.90		.99
6		1.55					0.68		.42			.84		.95
7		1.92					0.78		.42			.90		1.00
8		1.61					0.85		.42			.92		1.03
9		1.46					0.80		.37			.89		1.00
10		1.40					0.81		.39			.82		.99
11		1.65					0.76		.38			.73		.91
12		1.35					0.75		.32			.72		.91
13		1.66					0.79		.45			.78		.97
14		1.50					0.78		.34			.79		.96
15		1.46					0.76		.30			.72		.94

TABLE 3.2 (cont'd.) SEPTEMBER 1984 (mg/L)

DATE	PRE-CHLORINATION							POST-CHLORINATION						
	Cl_2		NH_3	SO_2	RESIDUAL Cl_2			Cl_2		NH_3	SO_2	RESIDUAL Cl_2		
	Dem.	Dos.			Free	Comb.	Total	Dem.	Dos.			Free	Comb.	Total
16		1.40					0.74		.38			.71		.89
17		1.41					0.78		.40			.82		.99
18		1.45					0.79		.35			.85		1.02
19		1.34					0.72		.39			.75		.92
20		1.32					0.75		.40			.83		.98
21		1.45					0.72		.44			.76		.92
22		1.41					0.73		.41			.72		.92
23		1.46					0.73		.40			.80		.97
24		1.44					0.70		.45			.70		.89
25		1.60					0.76		.39			.80		.97
26		1.74					0.76		.35			.78		.95
27		1.67					0.74		.41			.87		1.00
28		1.58					0.83		.48			.84		1.05
29		1.56					0.84		.47			.85		1.02
30		1.40					0.70		.47			.83		.97
31														

TABLE 3.2: DISINFECTION PROFILE OCTOBER 1984 (mg/L)

MOE WPOS PROTOCOL

DATE	PRE-CHLORINATION							POST-CHLORINATION						
	Cl_2		NH_3	SO_2	RESIDUAL Cl_2			Cl_2		NH_3	SO_2	RESIDUAL Cl_2		
	Dem.	Dos.			Free	Comb.	Total	Dem.	Dos.			Free	Comb.	Total
1		1.58					0.71		.40			.75		.93
2		1.61					0.68		.44			.71		.90
3		1.52					0.82		.48			.91		1.10
4		1.62					0.77		.34			.80		1.01
5		1.57					0.71		.37			.79		.94
6		1.61					0.73		.40			.81		.95
7		1.45					0.74		.41			.76		.94
8		1.36					0.80		.43			.89		1.00
9		1.51					0.82		.47			.86		1.05
10		1.42					0.78		.47			.79		.99
11		1.57					0.71		.47			.76		.96
12		1.53					0.72		.34			.48		.96
13		1.53					0.66		.50			.70		.90
14		1.46					0.71		.65			.69		.91
15		1.70					0.77		.40			.89		1.04

TABLE 3.2 (cont'd.) OCTOBER 1984 (mg/L)

DATE	PRE-CHLORINATION							POST-CHLORINATION						
	Cl_2		NH_3	SO_2	RESIDUAL Cl_2			Cl_2		NH_3	SO_2	RESIDUAL Cl_2		
	Dem.	Dos.			Free	Comb.	Total	Dem.	Dos.			Free	Comb.	Total
16		1.60					0.71		.42			.81		.93
17		1.63					0.73		.39			.80		.91
18		1.41					0.73		.40			.85		.97
19		1.54					0.73		.39			.84		.93
20		1.57					0.80		.39			.90		.99
21		1.56					0.80		.40			.84		.96
22		1.01					0.84		.36			.87		1.02
23		2.36					0.74		.41			.76		.95
24		1.15					0.71		.40			.85		.92
25		1.60					0.72		.39			.75		.94
26		1.49					0.70		.41			.80		.93
27		1.45					0.81		.41			.84		1.01
28		1.38					0.81		.41			.85		1.00
29		1.40					0.83		.35			.93		1.02
30		1.49					0.76		.35			.86		.95
31		1.49					0.83		.36			.87		1.01

TABLE 3.2: DISINFECTION PROFILE NOVEMBER 1984 (mg/L)

MOE WPOS PROTOCOL

DATE	PRE-CHLORINATION Cl_2 Dem.	PRE Cl_2 Dos.	PRE NH_3	PRE SO_2	PRE RESIDUAL Cl_2 Free	PRE RESIDUAL Cl_2 Comb.	PRE RESIDUAL Cl_2 Total	POST-CHLORINATION Cl_2 Dem.	POST Cl_2 Dos.	POST NH_3	POST SO_2	POST RESIDUAL Cl_2 Free	POST RESIDUAL Cl_2 Comb.	POST RESIDUAL Cl_2 Total
1		1.36					0.80		.28			.79		.97
2		1.59					0.80		.29			.82		.97
3		1.27					0.81		.29			.82		.99
4		1.23					0.74		.32			.76		.92
5		1.34					0.73		.35			.74		.94
6		1.28					0.76		.35			.80		.96
7		1.21					0.72		.35			.83		.93
8		1.18					0.71		.42			.80		.93
9		1.17					0.76		.46			.81		.97
10		1.27					0.72		.32			.80		.96
11		1.15					0.74		.33			.74		.91
12		1.29					0.76		.37			.84		.98
13		1.28					0.75		.34			.81		.97
14		1.28					0.76		.35			.88		.98
15		1.17					0.78		.30			.78		.98

TABLE 3.2 (cont'd.) NOVEMBER 1984 (mg/L)

DATE	PRE-CHLORINATION							POST-CHLORINATION						
	Cl_2		NH_3	SO_2	RESIDUAL Cl_2			Cl_2		NH_3	SO_2	RESIDUAL Cl_2		
	Dem.	Dos.			Free	Comb.	Total	Dem.	Dos.			Free	Comb.	Total
16		1.33					0.80		.35			.84		1.02
17		1.10					0.73		.35			.79		.96
18		1.08					0.70		.37			.75		.92
19		1.36					0.78		.31			.87		1.00
20		1.22					0.67		.31			.76		.90
21		1.24					0.69		.36			.76		.90
22		1.63					0.79		.35			.90		1.00
23		1.35					0.87		.29			.90		1.05
24		1.14					0.75		.32			.84		.95
25		1.25					0.74		.28			.83		.96
26		1.27					0.74		.36			.91		1.01
27		1.12					0.75		.35			.81		.97
28		1.16					0.74		.35			.83		.98
29		1.18					0.70		.35			.78		.95
30		1.22					0.78		.35			.87		.99
31														

TABLE 3.2: DISINFECTION PROFILE DECEMBER 1984 (mg/L)

MOE WPOS PROTOCOL

DATE	PRE-CHLORINATION Cl_2 Dem.	Cl_2 Dos.	NH_3	SO_2	RESIDUAL Cl_2 Free	Comb.	Total	POST-CHLORINATION Cl_2 Dem.	Cl_2 Dos.	NH_3	SO_2	RESIDUAL Cl_2 Free	Comb.	Total
1		1.31					0.80		.35			.78		.96
2		1.19					0.74		.35			.81		.98
3		1.21					0.77		.35			.85		.96
4		1.17					0.74		.35			.88		.98
5		1.23					0.73		.35			.84		.95
6		1.17					0.71		.33			.85		.93
7		1.40					0.74		.36			.91		1.00
8		1.13					0.77		.29			.91		.97
9		1.30					0.78		.34			.92		.97
10		1.21					0.75		.32			.90		1.00
11		1.21					0.78		.33			.87		1.00
12		1.28					0.73		.35			.81		.95
13		1.31					0.76		.35			.81		.97
14		1.40					0.76		.35			.84		1.00
15		1.27					0.72		.34			.76		.93

TABLE 3.2 (cont'd.) DECEMBER 1984 (mg/L)

DATE	PRE-CHLORINATION							POST-CHLORINATION						
	Cl_2		NH_3	SO_2	RESIDUAL Cl_2			Cl_2		NH_3	SO_2	RESIDUAL Cl_2		
	Dem.	Dos.			Free	Comb.	Total	Dem.	Dos.			Free	Comb.	Total
16		0.91					0.74		.34			.78		.94
17		1.31					0.78		.35			.90		1.01
18		0.94					0.76		.31			.83		.98
19		1.16					0.68		.32			.74		.86
20		1.14					0.74		.35			.80		.93
21		1.04					0.69		.31			.78		.93
22		1.01					0.69		.32			.71		.84
23		1.87					0.79		.32			.71		.87
24		1.10					0.75		.31			.81		.97
25		0.96					0.75		.33			.77		.94
26		1.12					0.74		.32			.78		.90
27		1.46					0.73		.33			.91		.94
28		1.13					0.76		.33			.80		.93
29		1.06					0.74		.33			.79		.93
30		1.06					0.76		.33			.77		.95
31		1.00					0.75		.32			.78		.94

TABLE 4

WATER PLANT OPTIMIZATION STUDY

"T & O CONTROL, ALKALINITY ADJ.
AND
FLUORIDATION SUMMARY"

TABLE 4.0: T&O CONTROL, ALKALINITY ADJ. &
FLUORIDATION SUMMARY (mg/L)

MOE WPOS PROTOCOL

		1986			1985			1984			1983		
		MIN.	MAX.	AVG.	MIN.	MAX.	AVG.	MIN.	MAX.	AVG.	MIN.	MAX.	AVG.
JAN	PAC	–	–	1.2	0.86	1.4	1.25	1.2	2.7	2.4			
	$KMnO_4$												
	Lime												
	Soda Ash												
	F Dos.	1.12	1.21	1.15	1.03	1.62	1.20	0.76	0.82	0.79			
	F Res.	1.05	1.48	1.32	1.06	1.50	1.30	0.90	1.25	1.03			
FEB	PAC	.04	1.1	0.7	–	–	–	1.3	4.2	2.1			
	$KMnO_4$												
	Lime												
	Soda Ash												
	F Dos.	0.85	1.20	1.13	1.00	1.44	1.23	0.77	1.17	0.81			
	F Res.	1.09	1.42	1.27	1.00	1.60	1.27	0.83	1.32	1.13			
MAR	PAC	0.93	1.4	1.40	0.5	3.1	1.9	1.0	2.5	1.4			
	$KMnO_4$												
	Lime												
	Soda Ash												
	F Dos.	1.03	1.17	1.08	0.99	1.40	1.30	0.78	0.81	0.79			
	F Res.	1.00	1.50	1.32	0.95	1.41	1.18	0.82	1.21	1.03			
APR	PAC	1.3	2.4	1.9	1.1	3.1	2.8	2.4	8.0	3.6			
	$KMnO_4$												
	Lime												
	Soda Ash												
	F Dos.	0.88	1.09	0.95	1.29	1.36	1.32	0.73	0.83	0.78			
	F Res.	1.03	1.48	1.25	0.95	1.33	1.15	0.80	1.60	1.11			
MAY	PAC	1.7	3.9	2.1	0.60	3.0	1.9	1.5	3.5	3.2			
	$KMnO_4$												
	Lime												
	Soda Ash												
	F Dos.	0.88	1.02	0.93	1.29	1.64	1.32	0.62	1.67	0.94			
	F Res.	1.10	1.39	1.25	0.99	1.42	1.24	0.50	1.48	1.02			
JUN	PAC	3.6	7.2	5.4	1.5	8.1	3.3	3.4	5.0	4.4			
	$KMnO_4$												
	Lime												
	Soda Ash												
	F Dos.	0.85	1.55	0.95	1.20	1.33	1.29	0.20	1.09	0.89			
	F Res.	0.98	1.42	1.24	1.02	1.38	1.22	0	1.50	1.03			

TABLE 4.0 (cont'd.) (mg/L)

		1986			1985			1984			1983		
		MIN.	MAX.	AVG.	MIN.	MAX.	AVG.	MIN.	MAX.	AVG.	MIN.	MAX.	AVG.
JUL	PAC	2.3	6.4	4.9	3.2	6.8	5.3	0.5	3.5	2.8			
	$KMnO_4$												
	Lime												
	Soda Ash												
	F Dos.	0.87	0.97	0.92	1.23	1.33	1.27	0.60	1.55	0.98			
	F Res.	0.99	1.34	1.17	0.98	1.49	1.20	0.55	0.55	1.00			
AUG	PAC	5.2	17.2	9.7	4.7	16.6	9.8	2.2	36.7	12.5			
	$KMnO_4$												
	Lime												
	Soda Ash												
	F Dos.	0.85	1.00	0.93	1.10	1.44	1.21	0.86	1.81	1.26			
	F Res.	0.82	1.35	1.17	0.98	1.55	1.38	0.96	1.85	1.25			
SEP	PAC	6.3	9.3	7.9	6.0	9.2	7.6	4.3	9.8	6.4			
	$KMnO_4$												
	Lime												
	Soda Ash												
	F Dos.	0.97	1.13	1.03	1.06	1.23	1.11	0.94	1.42	1.19			
	F Res.	0.88	1.39	1.13	1.20	1.60	1.39	0.98	1.50	1.21			
OCT	PAC	3.8	6.3	5.0	4.7	6.1	4.92	4.3	4.5	4.4			
	$KMnO_4$												
	Lime												
	Soda Ash												
	F Dos.	1.02	1.16	1.09	1.08	1.18	1.12	0.93	1.41	1.16			
	F Res.	0.95	1.35	1.14	1.05	1.49	1.32	1.05	1.44	1.27			
NOV	PAC	4.5	3.2	3.5	2.9	6.3	4.7	0.3	4.4	2.9			
	$KMnO_4$												
	Lime												
	Soda Ash												
	F Dos.	1.15	0.88	1.07	1.09	1.18	1.14	0.70	1.63	1.14			
	F Res.	1.50	0.95	1.19	1.02	1.38	1.25	0.91	1.53	1.25			
DEC	PAC	3.4	1.5	2.2	4.8	7.1	5.2	1.2	2.2	1.7			
	$KMnO_4$												
	Lime												
	Soda Ash												
	F Dos.	1.17	0.88	1.10	1.11	1.17	1.14	0.83	1.44	1.19			
	F Res.	1.29	0.92	1.11	0.98	1.55	1.28	0.82	1.45	1.24			

TABLE 4.1: T&O CONTROL, ALKALINITY ADJ. & FLUORIDATION PROFILE JANUARY 1986 (mg/L)

MOE WPOS PROTOCOL

DATE	PAC	$KMnO_4$	LIME	SODA ASH	$NaHCO_3$	FLUORIDE	
						Dosage	Residual
1	1.20					1.12	1.43
2						1.15	1.25
3						1.16	1.37
4						1.21	1.20
5						1.15	1.28
6						1.17	1.39
7						1.14	1.45
8						1.15	1.36
9						1.15	1.32
10						1.12	1.36
11						1.15	1.06
12						1.12	1.34
13						1.14	1.28
14						1.16	1.33
15						1.14	1.35

TABLE 4.1 (cont'd.) JANUARY 1986 (mg/L)

DATE	PAC	$KMnO_4$	LIME	SODA ASH	$NaHCO_3$	FLUORIDE Dosage	FLUORIDE Residual
16						1.16	1.35
17						1.16	1.32
18						1.14	1.38
19						1.13	1.32
20						1.15	1.08
21						1.14	1.35
22						1.16	1.38
23						1.14	1.48
24						1.16	1.32
25						1.16	1.30
26						1.14	1.25
27						1.17	1.05
28						1.20	1.37
29						1.15	1.36
30						1.13	1.38
31						1.14	1.36

TABLE 4.1: T&O CONTROL, ALKALINITY ADJ. & FLUORIDATION PROFILE FEBRUARY 1986 (mg/L)

MOE WPOS PROTOCOL

DATE	PAC	$KMnO_4$	LIME	SODA ASH	$NaHCO_3$	FLUORIDE Dosage	FLUORIDE Residual
1						1.13	1.25
2						1.13	1.34
3						1.14	1.18
4						1.13	1.38
5						1.15	1.39
6						.85	1.33
7						1.15	1.20
8						1.14	1.27
9						1.20	1.33
10						1.14	1.16
11						1.15	1.33
12						1.08	1.21
13						1.15	1.12
14						1.16	1.30
15						1.13	1.19

TABLE 4.1 (cont'd.) FEBRUARY 1986 (mg/L)

DATE	PAC	$KMnO_4$	LIME	SODA ASH	$NaHCO_3$	FLUORIDE Dosage	FLUORIDE Residual
16						1.10	1.42
17						1.14	1.32
18						1.15	1.40
19						1.12	1.35
20						1.13	1.25
21						1.18	1.28
22						1.14	1.30
23						1.14	1.25
24						1.14	1.32
25	.4					1.15	1.34
26	.4					1.15	1.26
27	.9					1.15	1.20
28	1.1					1.14	1.09
29							
30							
31							

TABLE 4.1: T&O CONTROL, ALKALINITY ADJ. & FLUORIDATION PROFILE MARCH 1986 (mg/L)

MOE WPOS PROTOCOL

DATE	PAC	$KMnO_4$	LIME	SODA ASH	$NaHCO_3$	FLUORIDE Dosage	FLUORIDE Residual
1	1.0					1.15	1.00
2	.93					1.13	1.18
3	1.26					1.10	1.28
4	1.4					1.08	1.18
5	1.4					1.17	1.35
6	1.4					1.08	1.32
7	1.4					1.09	1.30
8	1.4					1.07	1.22
9	1.4					1.03	1.32
10	1.4					1.08	1.36
11	1.4					1.05	1.29
12	1.4					1.08	1.35
13	1.4					1.09	1.22
14	1.4					1.07	1.35
15	1.4					1.07	1.20

TABLE 4.1 (cont'd.) MARCH 1986 (mg/L)

DATE	PAC	$KMnO_4$	LIME	SODA ASH	$NaHCO_3$	FLUORIDE Dosage	FLUORIDE Residual
16	1.4					1.05	1.50
17	1.4					1.11	1.38
18	1.4					1.08	1.50
19	1.4					1.08	1.45
20	1.4					1.07	1.34
21	1.4					1.07	1.38
22	1.4					1.09	1.35
23	1.4					1.11	1.43
24	1.4					1.06	1.19
25	1.4					1.08	1.46
26	1.4					1.08	1.28
27	1.4					1.07	1.25
28	1.4					1.08	1.34
29	1.4					1.12	1.40
30	1.4					1.04	1.36
31	1.4					1.09	1.30

TABLE 4.1: T&O CONTROL, ALKALINITY ADJ. & FLUORIDATION PROFILE APRIL 1986 (mg/L)

MOE WPOS PROTOCOL

DATE	PAC	$KMnO_4$	LIME	SODA ASH	$NaHCO_3$	FLUORIDE	
						Dosage	Residual
1	1.4					1.08	1.34
2	1.4					1.08	1.36
3	1.4					1.09	1.48
4	1.4					.89	1.35
5	1.4					.89	1.22
6	1.3					1.00	1.08
7	1.4					.88	1.03
8	2.1					.91	1.20
9	2.1					.91	1.16
10	2.1					.93	1.38
11	2.0					.91	1.30
12	2.0					.92	1.28
13	2.0					.89	1.32
14	2.0					.90	1.34
15	2.0					.91	1.38

TABLE 4.1 (cont'd.) APRIL 1986 (mg/L)

DATE	PAC	$KMnO_4$	LIME	SODA ASH	$NaHCO_3$	FLUORIDE Dosage	FLUORIDE Residual
16	2.0					.93	1.27
17	2.0					.94	1.24
18	2.0					.96	1.15
19	2.0					.96	1.18
20	2.0					.95	1.20
21	2.0					.96	1.05
22	1.8					.99	1.22
23	2.0					.95	1.26
24	2.0					.97	1.24
25	2.0					.97	1.22
26	2.0					.96	1.28
27	2.0					.96	1.22
28	2.0					.94	1.24
29	2.4					.97	1.19
30	2.0					.97	1.32
31							

TABLE 4.1: T&O CONTROL, ALKALINITY ADJ. & FLUORIDATION PROFILE MAY 1986 (mg/L)

MOE WPOS PROTOCOL

DATE	PAC	$KMnO_4$	LIME	SODA ASH	$NaHCO_3$	FLUORIDE Dosage	FLUORIDE Residual
1	2.0					.88	1.13
2	2.0					.99	1.12
3	2.0					.93	1.18
4	2.0					.96	1.25
5	2.0					.88	1.10
6	2.0					1.00	1.24
7	2.0					.91	1.15
8	2.0					.93	1.22
9	2.0					.95	1.32
10	2.4					.90	1.32
11	1.9					.95	1.39
12	2.0					.92	1.26
13	2.0					.93	1.35
14	2.0					.97	1.30
15	2.0					.94	1.20

TABLE 4.1 (cont'd.) MAY 1986 (mg/L)

DATE	PAC	$KMnO_4$	LIME	SODA ASH	$NaHCO_3$	FLUORIDE	
						Dosage	Residual
16	2.0					.91	1.28
17	1.8					.96	1.30
18	1.7					.90	1.29
19	2.0					.92	1.22
20	2.0					.91	1.32
21	2.0					.96	1.30
22	2.0					.95	1.34
23	2.0					.90	1.19
24	2.0					.92	1.23
25	2.0					.91	1.17
26	2.0					.95	1.16
27	2.0					.93	1.35
28	1.8					.93	1.20
29	2.9					1.02	1.15
30	3.9					.93	1.32
31	3.9					.94	1.26

TABLE 4.1: T&O CONTROL, ALKALINITY ADJ. & FLUORIDATION PROFILE JUNE 1986 (mg/L)

MOE WPOS PROTOCOL

DATE	PAC	$KMnO_4$	LIME	SODA ASH	$NaHCO_3$	FLUORIDE Dosage	FLUORIDE Residual
1	3.6					.89	1.28
2	4.0					.93	1.24
3	3.8					.87	1.21
4	4.3					.93	1.37
5	4.0					.96	1.32
6	3.7					.91	1.23
7	5.1					1.55	1.20
8	4.8					.87	1.02
9	5.0					.96	1.20
10	5.2					.97	1.42
11	5.8					.85	1.24
12	6.1					.97	1.20
13	5.3					.95	1.42
14	5.1					.90	1.32
15	5.6					.90	1.41

TABLE 4.1 (cont'd.) JUNE 1986 (mg/L)

DATE	PAC	$KMnO_4$	LIME	SODA ASH	$NaHCO_3$	FLUORIDE Dosage	FLUORIDE Residual
16	5.7					.96	1.08
17	4.9					.91	.98
18	4.5					.98	1.12
19	5.9					.89	1.18
20	7.2					.97	1.28
21	6.9					.93	1.30
22	6.8					.93	1.08
23	7.0					.95	1.40
24	7.0					.93	1.42
25	7.0					.94	1.22
26	5.2					.92	1.20
27	5.6					.90	1.18
28	5.3					1.06	1.38
29	5.2					.95	1.16
30	5.2					.87	1.03
31							

TABLE 4.1: T&O CONTROL, ALKALINITY ADJ. & FLUORIDATION PROFILE JULY 1986 (mg/L)

MOE WPOS PROTOCOL

DATE	PAC	$KMnO_4$	LIME	SODA ASH	$NaHCO_3$	FLUORIDE	
						Dosage	Residual
1	5.2					.95	1.23
2	5.2					.91	1.18
3	5.2					.96	1.26
4	5.2					.91	1.28
5	5.2					.91	1.09
6	5.2					.96	1.16
7	5.1					.93	1.28
8	5.0					.95	1.25
9	5.0					.89	1.34
10	4.5					.95	1.22
11	5.0					.91	1.23
12	3.9					.91	1.17
13	4.8					.91	1.10
14	4.9					.95	1.08
15	4.4					.93	1.07

TABLE 4.1 (cont'd.) JULY 1986 (mg/L)

DATE	PAC	$KMnO_4$	LIME	SODA ASH	$NaHCO_3$	FLUORIDE	
						Dosage	Residual
16	5.0					.95	1.20
17	4.5					.92	1.18
18	4.4					.89	1.18
19	4.6					.97	1.22
20	6.4					.87	1.12
21	4.9					.90	1.21
22	4.7					.96	1.13
23	5.8					.75	1.03
24	5.5					.93	1.00
25	5.1					.89	1.28
26	4.7					.96	.99
27	5.1					.94	1.16
28	4.6					.89	1.20
29	2.3					.91	1.26
30	5.7					.94	1.08
31	5.7					.92	1.20

TABLE 4.1: T&O CONTROL, ALKALINITY ADJ. & FLUORIDATION PROFILE AUGUST 1986 (mg/L)

MOE WPOS PROTOCOL

DATE	PAC	$KMnO_4$	LIME	SODA ASH	$NaHCO_3$	FLUORIDE	
						Dosage	Residual
1	5.7					.95	1.22
2	6.9					.90	1.34
3	5.6					.96	1.29
4	5.2					.85	1.19
5	5.7					.94	1.35
6	7.7					.95	1.22
7	9.5					.96	1.18
8	9.3					.90	.99
9	12.4					.91	1.20
10	16.9					.90	1.22
11	17.2					.96	1.24
12	14.0					.90	1.28
13	11.9					.92	1.18
14	11.9					.94	1.01
15	12.1					.95	1.28

DATE	PAC	$KMnO_4$	LIME	SODA ASH	$NaHCO_3$	FLUORIDE	
						Dosage	Residual
16	11.5					.93	1.13
17	9.1					.93	1.29
18	9.2					.91	1.20
19	10.7					.92	1.20
20	9.2					.98	1.15
21	9.1					.85	1.22
22	9.4					.95	1.18
23	8.0					.88	1.18
24	8.7					.89	1.24
25	9.2					.91	1.16
26	9.2					.93	.82
27	9.2					.90	1.04
28	8.6					1.00	.96
29	9.2					.99	1.23
30	9.0					.98	1.10
31	8.5					.97	1.05

TABLE 4.1: T&O CONTROL, ALKALINITY ADJ. & FLUORIDATION PROFILE SEPTEMBER 1986 (mg/L)

MOE WPOS PROTOCOL

DATE	PAC	$KMnO_4$	LIME	SODA ASH	$NaHCO_3$	FLUORIDE	
						Dosage	Residual
1	8.4					1.05	1.10
2	9.3					1.01	1.05
3	9.3					1.04	1.12
4	9.3					.97	1.08
5	9.3					.98	1.38
6	9.1					.97	1.08
7	8.8					.99	1.03
8	9.0					.94	.88
9	9.2					1.03	1.04
10	9.2					1.01	1.05
11	9.3					.97	1.32
12	9.3					.95	1.15
13	8.1					1.01	1.09
14	9.0					1.02	1.06
15	9.0					1.02	1.23

TABLE 4.1 (cont'd.) SEPTEMBER 1986 (mg/L)

DATE	PAC	$KMnO_4$	LIME	SODA ASH	$NaHCO_3$	FLUORIDE Dosage	FLUORIDE Residual
16	8.6					1.02	1.08
17	6.7					.99	1.10
18	6.8					1.09	1.08
19	6.5					1.05	1.13
20	6.5					1.07	1.29
21	6.7					1.09	1.39
22	6.4					1.12	1.23
23	6.7					1.07	1.28
24	6.7					1.09	1.18
25	6.6					1.03	1.14
26	6.7					1.12	1.17
27	6.3					1.09	1.02
28	6.5					1.06	1.16
29	6.7					1.13	.99
30	6.5					1.06	.97
31							

TABLE 4.1: T&O CONTROL, ALKALINITY ADJ. & FLUORIDATION PROFILE OCTOBER 1986 (mg/L)

MOE WPOS PROTOCOL

DATE	PAC	$KMnO_4$	LIME	SODA ASH	$NaHCO_3$	FLUORIDE Dosage	FLUORIDE Residual
1	6.5					1.03	1.09
2	4.8					1.07	1.01
3	4.3					1.11	1.10
4	3.8					1.12	1.13
5	4.1					1.02	1.12
6	4.2					1.08	.95
7	4.2					1.08	.98
8	5.7					1.15	1.04
9	6.3					1.02	1.02
10	6.1					1.15	1.22
11	6.0					1.05	1.10
12	5.9					1.10	1.20
13	5.9					1.11	1.17
14	6.1					1.07	1.32
15	6.0					1.13	1.13

TABLE 4.1 (cont'd.) OCTOBER 1986 (mg/L)

DATE	PAC	$KMnO_4$	LIME	SODA ASH	$NaHCO_3$	FLUORIDE Dosage	FLUORIDE Residual
16	5.0					1.09	1.22
17	4.9					1.13	1.35
18	4.9					1.02	1.22
19	4.7					1.16	1.20
20	4.9					1.10	1.23
21	5.0					1.09	1.20
22	5.1					1.08	1.18
23	5.0					1.11	1.12
24	4.6					1.09	1.12
25	4.6					1.05	1.19
26	4.4					1.08	1.04
27	4.6					1.06	1.15
28	4.7					1.12	1.12
29	4.7					1.08	1.05
30	4.7					1.12	1.18
31	4.6					1.12	1.26

TABLE 4.1: T&O CONTROL, ALKALINITY ADJ. & FLUORIDATION PROFILE November 1986 (mg/L)

MOE WPOS PROTOCOL

DATE	PAC	$KMnO_4$	LIME	SODA ASH	$NaHCO_3$	FLUORIDE	
						Dosage	Residual
1	4.0					1.06	1.22
2	3.5					1.09	1.17
3	3.7					1.04	1.36
4	4.5					1.13	1.38
5	3.6					1.03	1.40
6	3.6					0.97	1.50
7	3.6					0.93	1.00
8	3.6					0.88	1.02
9	3.4					0.96	0.95
10	3.6					1.05	1.00
11	3.5					1.12	1.20
12	3.5					1.11	1.20
13	3.4					1.06	1.22
14	4.0					1.11	1.28
15	3.5					1.08	1.26

TABLE 4.1 (cont'd.) November 1986 (mg/L)

DATE	PAC	$KMnO_4$	LIME	SODA ASH	$NaHCO_3$	FLUORIDE	
						Dosage	Residual
16	3.4					1.10	1.20
17	3.4					1.10	1.28
18	3.4					1.10	1.39
19	3.3					1.06	1.19
20	3.2					1.14	1.00
21	3.3					1.06	1.02
22	3.4					1.12	1.18
23	3.3					1.07	1.09
24	3.4					1.11	1.18
25	3.4					1.11	1.22
26	3.3					1.15	1.18
27	3.4					1.08	1.16
28	3.4					1.09	1.22
29	3.4					1.13	1.20
30	3.4					1.06	1.02
31							

TABLE 4.1: T&O CONTROL, ALKALINITY ADJ. & FLUORIDATION PROFILE December 1986 (mg/L)

MOE WPOS PROTOCOL

DATE	PAC	$KMnO_4$	LIME	SODA ASH	$NaHCO_3$	FLUORIDE Dosage	FLUORIDE Residual
1	3.4					1.08	0.92
2	2.1					1.08	1.10
3	3.3					1.12	1.10
4	3.4					1.15	1.13
5	2.1					1.02	1.10
6	1.6					1.17	1.23
7	1.5					1.14	1.19
8	1.7					1.07	1.08
9	1.6					1.05	1.05
10	1.8					1.13	1.14
11	2.5					1.14	1.10
12	2.1					1.04	1.08
13	2.1					1.16	0.98
14	2.1					1.11	1.19
15	2.2					1.06	1.05

TABLE 4.1 (cont'd.) December 1986 (mg/L)

DATE	PAC	$KMnO_4$	LIME	SODA ASH	$NaHCO_3$	FLUORIDE Dosage	FLUORIDE Residual
16	2.2					1.06	1.12
17	2.1					1.14	1.05
18	2.1					1.13	1.12
19	2.2					1.13	1.13
20	2.0					1.15	1.18
21	2.1					1.00	1.10
22	2.1					1.08	1.24
23	2.1					1.12	1.24
24	2.1					1.19	1.29
25	2.0					0.88	1.13
26	2.0					1.06	1.05
27	2.1					1.16	1.05
28	2.0					1.17	1.05
29	2.0					1.07	1.00
30	2.0					1.12	1.14
31	2.1					1.07	1.21

TABLE 4.1: T&O CONTROL, ALKALINITY ADJ. & FLUORIDATION PROFILE JANUARY 1985 (mg/L)

MOE WPOS PROTOCOL

DATE	PAC	$KMnO_4$	LIME	SODA ASH	$NaHCO_3$	FLUORIDE	
						Dosage	Residual
1						1.31	1.28
2						1.20	1.30
3						1.11	1.25
4						1.13	1.34
5						1.62	1.22
6						1.16	1.20
7						1.19	1.15
8						1.16	1.30
9						1.07	1.34
10						1.43	1.35
11						1.35	1.35
12						1.38	1.26
13						1.20	1.18
14						1.20	1.28
15						1.15	1.32

TABLE 4.1 (cont'd.) JANUARY 1985 (mg/L)

DATE	PAC	$KMnO_4$	LIME	SODA ASH	$NaHCO_3$	FLUORIDE Dosage	FLUORIDE Residual
16	.86					1.08	1.30
17	1.4					1.08	1.21
18	1.4					1.05	1.20
19	1.2					1.06	1.10
20	1.4					1.20	1.43
21	1.4					1.40	1.35
22	1.1					1.03	1.30
23						1.10	1.33
24						1.26	1.48
25						1.02	1.29
26						1.17	1.36
27						1.29	1.34
28						1.33	1.50
29						1.17	1.06
30						1.17	1.45
31						1.18	1.48

TABLE 4.1: T&O CONTROL, ALKALINITY ADJ. & FLUORIDATION PROFILE FEBRUARY 1985

(mg/L)

MOE WPOS PROTOCOL

DATE	PAC	$KMnO_4$	LIME	SODA ASH	$NaHCO_3$	FLUORIDE	
						Dosage	Residual
1						1.16	1.18
2						1.22	1.20
3						1.34	1.35
4						1.29	1.36
5						1.26	1.58
6						1.19	1.25
7						1.20	1.15
8						1.15	1.10
9						1.17	1.22
10						1.18	1.22
11						1.20	1.15
12						1.20	1.28
13						1.20	1.18
14						1.24	1.28
15						1.20	1.29

TABLE 4.1 (cont'd.) FEBRUARY 1985 (mg/L)

DATE	PAC	$KMnO_4$	LIME	SODA ASH	$NaHCO_3$	FLUORIDE	
						Dosage	Residual
16						1.22	1.33
17						1.38	1.18
18						1.44	1.24
19						1.27	1.40
20						1.18	1.60
21						1.21	1.00
22						1.00	1.12
23						1.17	1.25
24						1.24	1.45
25						1.24	1.25
26						1.29	1.33
27						1.34	1.28
28						1.38	1.44
29							
30							
31							

TABLE 4.1: T&O CONTROL, ALKALINITY ADJ. & FLUORIDATION PROFILE MARCH 1985

(mg/L)

MOE WPOS PROTOCOL

DATE	PAC	$KMnO_4$	LIME	SODA ASH	$NaHCO_3$	FLUORIDE Dosage	FLUORIDE Residual
1						1.27	1.38
2						1.29	1.32
3						1.30	1.30
4						1.18	1.05
5						1.08	1.05
6						.99	1.00
7						1.33	1.12
8						1.29	1.30
9						1.33	1.09
10						1.36	1.19
11						1.31	1.33
12						1.35	0.98
13						1.30	1.00
14						1.32	1.28
15						1.33	1.08

TABLE 4.1 (cont'd.) MARCH 1985 (mg/L)

DATE	PAC	$KMnO_4$	LIME	SODA ASH	$NaHCO_3$	FLUORIDE Dosage	FLUORIDE Residual
16						1.34	1.17
17						1.40	1.25
18						1.33	1.00
19						1.33	1.25
20						1.33	1.23
21						1.35	1.00
22						1.38	1.23
23						1.34	1.28
24						1.32	1.34
25	.5					1.34	1.24
26	1.4					1.32	1.32
27	1.4					1.33	1.24
28	1.4					1.29	1.41
29	2.5					1.34	1.00
30	3.1					1.33	1.10
31	2.9					1.29	.95

TABLE 4.1: T&O CONTROL, ALKALINITY ADJ. & FLUORIDATION PROFILE APRIL 1985

(mg/L)

MOE WPOS PROTOCOL

DATE	PAC	$KMnO_4$	LIME	SODA ASH	$NaHCO_3$	FLUORIDE	
						Dosage	Residual
1	3.1					1.32	1.28
2	3.1					1.31	1.00
3	3.1					1.36	1.26
4	3.1					1.34	1.16
5	3.1					1.30	1.05
6	2.9					1.29	1.18
7	3.0					1.32	1.15
8	3.1					1.32	1.08
9	3.1					1.30	1.02
10	3.1					1.32	1.19
11	2.7					1.32	.95
12	1.1					1.32	1.05
13	1.8					1.34	1.32
14	0					1.30	1.32
15	0					1.35	1.09

TABLE 4.1 (cont'd.) APRIL 1985 (mg/L)

DATE	PAC	$KMnO_4$	LIME	SODA ASH	$NaHCO_3$	FLUORIDE Dosage	FLUORIDE Residual
16						1.31	1.10
17						1.33	1.08
18						1.33	1.24
19						1.31	1.28
20						1.33	1.15
21						1.25	1.00
22						1.33	1.00
23						1.33	1.05
24						1.34	1.13
25						1.36	1.20
26						1.33	1.11
27						1.35	1.18
28						1.30	1.33
29						1.33	1.20
30						1.34	1.26
31							

TABLE 4.1: T&O CONTROL, ALKALINITY ADJ. & FLUORIDATION PROFILE MAY 1985 (mg/L)

MOE WPOS PROTOCOL

DATE	PAC	$KMnO_4$	LIME	SODA ASH	$NaHCO_3$	FLUORIDE Dosage	FLUORIDE Residual
1						1.33	1.28
2						1.31	1.42
3						1.33	0.99
4						1.36	1.32
5						1.64	1.09
6						1.32	1.28
7						1.33	1.20
8						1.32	1.40
9						1.33	1.12
10	.6					1.30	1.02
11	2.0					1.29	1.10
12	1.8					1.28	1.38
13	1.8					1.33	1.26
14	1.3					1.33	1.42
15	1.6					1.30	1.22

TABLE 4.1 (cont'd.) MAY 1985 (mg/L)

DATE	PAC	$KMnO_4$	LIME	SODA ASH	$NaHCO_3$	FLUORIDE	
						Dosage	Residual
16	1.8					1.29	1.24
17	1.7					1.29	1.13
18	1.8					1.33	1.23
19	2.1					1.31	1.25
20	1.7					1.29	1.28
21	1.8					1.37	1.30
22	2.6					1.31	1.33
23	2.0					1.33	1.28
24	2.1					1.32	1.28
25	1.8					1.29	1.34
26	1.7					1.31	1.26
27	2.1					1.27	1.30
28	2.3					1.32	1.11
29	3.0					1.32	1.27
30	2.2					1.31	1.05
31	1.9					1.30	1.14

TABLE 4.1: T&O CONTROL, ALKALINITY ADJ. & FLUORIDATION PROFILE JUNE 1985

(mg/L)

MOE WPOS PROTOCOL

DATE	PAC	$KMnO_4$	LIME	SODA ASH	$NaHCO_3$	FLUORIDE Dosage	FLUORIDE Residual
1	1.5					1.30	1.03
2	1.8					1.32	1.28
3	2.0					1.27	1.21
4	2.2					1.31	1.21
5	2.6					1.28	1.38
6	2.1					1.29	1.32
7	2.1					1.28	1.28
8	2.0					1.29	1.15
9	2.1					1.28	1.24
10	2.2					1.31	1.37
11	2.1					1.30	1.32
12	1.7					1.29	1.20
13	2.4					1.32	1.30
14	1.7					1.35	1.08
15	1.9					1.31	1.28

DATE	PAC	$KMnO_4$	LIME	SODA ASH	$NaHCO_3$	FLUORIDE	
						Dosage	Residual
16	2.3					1.30	1.21
17	3.8					1.30	1.18
18	5.0					1.31	1.22
19	3.9					1.29	1.24
20	3.2					1.27	1.35
21	3.4					1.33	1.05
22	3.4					1.31	1.22
23	3.7					1.25	1.10
24	3.6					1.27	1.02
25	3.5					1.26	1.12
26	7.8					1.31	1.15
27	8.1					1.28	1.24
28	5.7					1.29	1.25
29	7.0					1.26	1.28
30	5.1					1.20	1.22
31							

TABLE 4.1: T&O CONTROL, ALKALINITY ADJ. & FLUORIDATION PROFILE JULY 1985

(mg/L)

MOE WPOS PROTOCOL

DATE	PAC	$KMnO_4$	LIME	SODA ASH	$NaHCO_3$	FLUORIDE Dosage	FLUORIDE Residual
1	5.2					1.28	1.28
2	6.8					1.25	1.49
3	6.8					1.30	1.31
4	5.7					1.28	1.31
5	5.9					1.26	1.00
6	4.7					1.24	1.21
7	3.5					1.23	1.05
8	5.7					1.31	1.24
9	4.4					1.27	1.32
10	3.2					1.28	1.18
11	3.2					1.28	1.26
12	5.5					1.31	1.18
13	5.5					1.31	1.13
14	5.4					1.23	.99
15	5.5					1.23	.99

TABLE 4.1 (cont'd.) JULY 1985 (mg/L)

DATE	PAC	$KMnO_4$	LIME	SODA ASH	$NaHCO_3$	FLUORIDE Dosage	FLUORIDE Residual
16	5.7					1.24	.98
17	5.4					1.28	1.12
18	5.2					1.26	1.32
19	5.6					1.26	1.05
20	5.5					1.30	1.45
21	5.6					1.26	1.12
22	5.6					1.29	1.27
23	5.6					1.29	1.26
24	5.6					1.33	1.28
25	5.6					1.27	1.20
26	5.6					1.28	1.08
27	5.5					1.26	1.28
28	5.5					1.28	1.36
29	5.2					1.29	1.15
30	5.7					1.28	1.16
31	5.5					1.24	1.05

TABLE 4.1: T&O CONTROL, ALKALINITY ADJ. & FLUORIDATION PROFILE AUGUST 1985 (mg/L)

MOE WPOS PROTOCOL

DATE	PAC	$KMnO_4$	LIME	SODA ASH	$NaHCO_3$	FLUORIDE Dosage	FLUORIDE Residual
1	5.5					1.29	1.21
2	5.6					1.28	1.30
3	5.6					1.29	1.50
4	5.4					1.26	1.45
5	5.6					1.44	1.35
6	5.5					1.24	1.50
7	5.8					1.20	1.31
8	7.3					1.21	1.33
9	11.2					1.21	1.40
10	4.7					1.20	1.53
11	6.1					1.21	1.45
12	11.8					1.18	1.25
13	11.6					1.25	1.31
14	16.6					1.18	1.26
15	13.5					1.21	1.22

TABLE 4.1 (cont'd.) AUGUST 1985 (mg/L)

DATE	PAC	$KMnO_4$	LIME	SODA ASH	$NaHCO_3$	FLUORIDE Dosage	FLUORIDE Residual
16	11.9					1.17	1.27
17	11.6					1.17	1.36
18	11.7					1.18	1.30
19	11.8					1.18	1.42
20	12.1					1.21	1.42
21	11.8					1.18	1.38
22	15.3					1.19	1.40
23	12.1					1.23	1.48
24	11.7					1.12	1.53
25	11.7					1.10	1.58
26	11.8					1.18	.98
27	11.8					1.23	1.36
28	11.6					1.18	1.48
29	9.7					1.21	1.43
30	7.9					1.21	1.50
31	7.6					1.12	1.55

TABLE 4.1: T&O CONTROL, ALKALINITY ADJ. & FLUORIDATION PROFILE SEPTEMBER 1985 (mg/L)

MOE WPOS PROTOCOL

DATE	PAC	$KMnO_4$	LIME	SODA ASH	$NaHCO_3$	FLUORIDE Dosage	FLUORIDE Residual
1	7.6					1.09	1.37
2	7.7					1.06	1.35
3	7.9					1.10	1.40
4	7.9					1.09	1.31
5	8.0					1.11	1.55
6	8.0					1.13	1.45
7	7.8					1.08	1.43
8	9.1					1.10	1.40
9	9.2					1.09	1.55
10	8.4					1.11	1.48
11	7.6					1.11	1.28
12	7.7					1.10	1.44
13	7.6					1.11	1.20
14	7.3					1.10	1.42
15	7.4					1.11	1.51

TABLE 4.1 (cont'd.) SEPTEMBER 1985 (mg/L)

DATE	PAC	$KMnO_4$	LIME	SODA ASH	$NaHCO_3$	FLUORIDE	
						Dosage	Residual
16	7.7					1.13	1.60
17	7.8					1.13	1.40
18	7.8					1.14	1.54
19	7.8					1.09	1.30
20	7.8					1.12	1.22
21	7.6					1.07	1.36
22	7.8					1.10	1.30
23	7.9					1.12	1.35
24	7.9					1.07	1.46
25	8.4					1.23	1.44
26	6.6					1.10	1.21
27	6.3					1.12	1.43
28	6.2					1.12	1.30
29	6.0					1.10	1.26
30	6.1					1.16	1.26
31							

TABLE 4.1: T&O CONTROL, ALKALINITY ADJ. & FLUORIDATION PROFILE OCTOBER 1985

(mg/L)

MOE WPOS PROTOCOL

DATE	PAC	$KMnO_4$	LIME	SODA ASH	$NaHCO_3$	FLUORIDE Dosage	FLUORIDE Residual
1	6.1					1.11	1.28
2	5.4					1.12	1.05
3	4.9					1.14	1.30
4	5.1					1.13	1.32
5	4.9					1.12	1.32
6	4.9					1.11	1.48
7	4.9					1.14	1.47
8	4.8					1.15	1.49
9	4.5					1.11	1.40
10	4.9					1.18	1.20
11	5.0					1.14	1.27
12	5.0					1.15	1.35
13	5.0					1.08	1.38
14	5.0					1.12	1.42
15	4.9					1.11	1.37

TABLE 4.1 (cont'd.) OCTOBER 1985 (mg/L)

DATE	PAC	$KMnO_4$	LIME	SODA ASH	$NaHCO_3$	FLUORIDE Dosage	FLUORIDE Residual
16	4.9					1.10	1.30
17	4.9					1.14	1.25
18	4.9					1.09	1.37
19	4.9					1.09	1.36
20	4.9					1.13	1.23
21	4.9					1.10	1.40
22	4.8					1.10	1.10
23	4.8					1.12	1.31
24	4.8					1.14	1.19
25	4.8					1.13	1.30
26	4.8					1.10	1.35
27	4.8					1.08	1.32
28	4.8					1.12	1.42
29	4.8					1.12	1.18
30	4.8					1.09	1.24
31	4.7					1.12	1.42

TABLE 4.1: T&O CONTROL, ALKALINITY ADJ. & FLUORIDATION PROFILE NOVEMBER 1985 (mg/L)

MOE WPOS PROTOCOL

DATE	PAC	$KMnO_4$	LIME	SODA ASH	$NaHCO_3$	FLUORIDE Dosage	FLUORIDE Residual
1	4.8					1.11	1.38
2	4.8					1.11	1.28
3	4.9					1.10	1.22
4	4.9					1.11	1.02
5	4.9					1.18	1.25
6	4.3					1.14	1.28
7	6.3					1.12	1.28
8	2.9					1.14	1.22
9	3.0					1.15	1.28
10	4.7					1.14	1.28
11	4.2					1.13	1.19
12	4.2					1.16	1.21
13	4.5					1.14	1.03
14	3.0					1.14	1.32
15	3.0					1.13	1.30

TABLE 4.1 (cont'd.) NOVEMBER 1985 (mg/L)

DATE	PAC	$KMnO_4$	LIME	SODA ASH	$NaHCO_3$	FLUORIDE Dosage	FLUORIDE Residual
16	3.2					1.15	1.32
17	3.3					1.17	1.30
18	3.2					1.16	1.38
19	3.4					1.09	1.28
20	5.5					1.13	1.36
21	6.0					1.14	1.24
22	5.9					1.14	1.18
23	5.8					1.11	1.28
24	5.7					1.14	1.02
25	5.6					1.12	1.29
26	5.9					1.14	1.18
27	5.8					1.12	1.27
28	5.9					1.14	1.35
29	5.9					1.18	1.25
30	5.9					1.13	1.28
31							

TABLE 4.1: T&O CONTROL, ALKALINITY ADJ. & FLUORIDATION PROFILE DECEMBER 1985 (mg/L)

MOE WPOS PROTOCOL

DATE	PAC	$KMnO_4$	LIME	SODA ASH	$NaHCO_3$	FLUORIDE Dosage	FLUORIDE Residual
1	5.9					1.13	1.35
2	5.8					1.12	1.32
3	5.5					1.14	1.40
4	5.4					1.13	1.35
5	5.1					1.14	1.18
6	5.2					1.14	.98
7	5.2					1.14	1.33
8	5.1					1.13	1.42
9	5.3					1.16	1.10
10	5.4					1.13	1.25
11	5.4					1.17	1.25
12	5.4					1.17	1.27
13	5.2					1.14	1.30
14	5.0					1.12	1.26
15	5.5					1.11	1.38

TABLE 4.1 (cont'd.) DECEMBER 1985 (mg/L)

DATE	PAC	$KMnO_4$	LIME	SODA ASH	$NaHCO_3$	FLUORIDE Dosage	FLUORIDE Residual
16	5.1					1.15	1.26
17	5.0					1.12	1.35
18	4.9					1.14	1.12
19	5.0					1.17	1.35
20	5.0					1.13	1.30
21	5.0					1.16	1.20
22	4.9					1.12	1.40
23	5.0					1.14	1.55
24	4.9					1.17	1.30
25	4.9					1.14	1.22
26	4.8					1.11	1.28
27	5.0					1.13	1.32
28	4.9					1.11	1.33
29	4.9					1.13	1.13
30	50					1.15	1.20
31	7.1					1.14	1.19

TABLE 4.1: T&O CONTROL, ALKALINITY ADJ. & FLUORIDATION PROFILE JANUARY 1984

(mg/L)

MOE WPOS PROTOCOL

DATE	PAC	$KMnO_4$	LIME	SODA ASH	$NaHCO_3$	FLUORIDE Dosage	FLUORIDE Residual
1	2.2					.77	1.18
2	2.4					.77	1.20
3	2.4					.78	.90
4	2.5					.79	.98
5	2.5					.79	1.00
6	2.5					.78	.95
7	2.5					.79	.92
8	2.3					.77	.90
9	2.5					.78	.95
10	2.5					.79	1.08
11	2.5					.76	.98
12	2.5					.77	1.01
13	2.4					.81	.98
14	2.4					.82	1.04
15	2.4					.80	1.00

TABLE 4.1 (cont'd.) JANUARY 1984 (mg/L)

DATE	PAC	$KMnO_4$	LIME	SODA ASH	$NaHCO_3$	FLUORIDE	
						Dosage	Residual
16	2.5					.81	1.05
17	2.5					.78	1.03
18	2.5					.79	1.18
19	2.7					.77	.99
20	2.5					.79	.96
21	2.5					.80	1.25
22	2.5					.79	1.00
23	2.5					.78	.95
24	1.2					.79	1.25
25	1.5					.80	.95
26	2.5					.78	1.07
27	2.5					.78	.98
28	2.5					.79	.98
29	2.5					.78	1.00
30	2.5					.78	.98
31	2.4					.79	1.25

TABLE 4.1: T&O CONTROL, ALKALINITY ADJ. & FLUORIDATION PROFILE FEBRUARY 1984

(mg/L)

MOE WPOS PROTOCOL

DATE	PAC	$KMnO_4$	LIME	SODA ASH	$NaHCO_3$	FLUORIDE Dosage	FLUORIDE Residual
1	2.9					.77	1.05
2	4.2					.85	1.20
3	3.5					.87	1.00
4	3.2					.79	1.00
5	3.2					.79	1.04
6	3.2					.79	1.32
7	3.2					.82	.92
8	3.2					.80	1.11
9	3.2					.79	1.21
10	3.0					.81	1.15
11	2.7					.81	1.18
12	2.7					.79	1.22
13	2.1					.81	1.08
14	1.3					.81	1.28
15	1.3					.81	1.21

TABLE 4.1 (cont'd.) FEBRUARY 1984 (mg/L)

DATE	PAC	$KMnO_4$	LIME	SODA ASH	$NaHCO_3$	FLUORIDE Dosage	FLUORIDE Residual
16	1.3					.77	1.24
17	1.3					.78	1.16
18	1.3					.79	1.10
19	1.3					.79	1.22
20	1.3					.79	.83
21	1.3					.78	1.30
22	1.4					.80	1.30
23	1.3					.78	1.08
24	1.3					.78	1.00
25	1.3					.78	1.02
26	1.3					.78	1.13
27	1.3					.80	1.09
28	1.3					1.17	1.03
29	1.3					.79	1.20
30							
31							

TABLE 4.1: T&O CONTROL, ALKALINITY ADJ. & FLUORIDATION PROFILE MARCH 1984 (mg/L)

MOE WPOS PROTOCOL

DATE	PAC	$KMnO_4$	LIME	SODA ASH	$NaHCO_3$	FLUORIDE Dosage	FLUORIDE Residual
1	1.3					.81	1.07
2	1.3					.79	1.10
3	1.3					.78	1.12
4	1.2					.79	1.21
5	1.3					.79	1.11
6	1.0					.81	1.21
7	1.3					.79	1.18
8	1.3					.77	.98
9	1.3					.79	.98
10	1.3					.79	1.18
11	1.2					.78	1.15
12	1.3					.78	1.00
13	1.3					.79	1.03
14	1.3					.79	0.85
15	1.3					.78	1.01

TABLE 4.1 (cont'd.) MARCH 1984 (mg/L)

DATE	PAC	$KMnO_4$	LIME	SODA ASH	$NaHCO_3$	FLUORIDE Dosage	FLUORIDE Residual
16	1.3					.78	1.00
17	1.3					.78	.92
18	1.3					.78	1.08
19	1.3					.79	.88
20	1.3					.81	1.05
21	1.3					.77	1.10
22	1.3					.79	.82
23	1.3					.79	1.05
24	1.3					.78	.85
25	1.3					.78	.97
26	1.3					.79	.91
27	1.3					.78	.98
28	1.3					.79	1.15
29	1.3					.81	.88
30	2.3					.79	1.02
31	2.5					.79	1.10

TABLE 4.1: T&O CONTROL, ALKALINITY ADJ. & FLUORIDATION PROFILE APRIL 1984

(mg/L)

MOE WPOS PROTOCOL

DATE	PAC	$KMnO_4$	LIME	SODA ASH	$NaHCO_3$	FLUORIDE Dosage	FLUORIDE Residual
1	2.4					.79	.97
2	2.4					.79	1.30
3	2.5					.79	1.00
4	2.5					.78	1.10
5	2.5					.80	1.06
6	2.5					.80	.65
7	2.4					.83	1.02
8	2.5					.79	.96
9	2.4					.83	1.23
10	3.1					.81	1.18
11	6.5					.77	1.25
12	8.0					.77	.99
13	5.0					.79	1.18
14	3.9					.79	1.25
15	3.9					.79	1.05

TABLE 4.1 (cont'd.) APRIL 1984 (mg/L)

DATE	PAC	$KMnO_4$	LIME	SODA ASH	$NaHCO_3$	FLUORIDE	
						Dosage	Residual
16	3.9					.79	.80
17	5.1					.79	.83
18	4.4					.79	1.17
19	4.3					.79	1.27
20	4.3					.79	1.28
21	3.7					.76	1.60
22	3.4					.75	1.22
23	3.4					.73	1.35
24	3.4					.74	1.05
25	3.4					.74	1.32
26	3.4					.75	.98
27	3.4					.75	1.10
28	3.4					.73	1.01
29	3.4					.73	1.10
30	3.5					.76	1.10
31							

TABLE 4.1: T&O CONTROL, ALKALINITY ADJ. & FLUORIDATION PROFILE MAY 1984

(mg/L)

MOE WPOS PROTOCOL

DATE	PAC	$KMnO_4$	LIME	SODA ASH	$NaHCO_3$	FLUORIDE Dosage	FLUORIDE Residual
1	3.3					.74	1.30
2	3.4					.74	1.18
3	3.4					.76	1.22
4	3.4					.76	.98
5	3.4					.73	1.04
6	3.5					.77	1.22
7	3.4					.76	1.14
8	3.4					.74	1.19
9	3.4					.73	.82
10	3.4					.85	1.05
11	3.4					.85	.90
12	3.4					.86	.95
13	3.4					.86	.89
14	3.4					.94	.89
15	3.4					.93	.98

TABLE 4.1 (cont'd.) MAY 1984 (mg/L)

DATE	PAC	$KMnO_4$	LIME	SODA ASH	$NaHCO_3$	FLUORIDE	
						Dosage	Residual
16	3.4					.95	1.09
17	3.4					.74	1.05
18	3.4					.95	.95
19	3.4					.95	.93
20	3.4					–	.50
21	3.4					.62	.61
22	3.3					.76	.78
23	3.4					1.10	.65
24	3.2					1.67	1.12
25	3.0					1.49	1.40
26	3.4					1.27	1.23
27	2.6					1.17	1.20
28	1.5					1.13	1.48
29	2.9					1.08	1.00
30	1.6					1.10	1.02
31	2.2					1.09	.95

TABLE 4.1: T&O CONTROL, ALKALINITY ADJ. & FLUORIDATION PROFILE JUNE 1984 (mg/L)

MOE WPOS PROTOCOL

DATE	PAC	$KMnO_4$	LIME	SODA ASH	$NaHCO_3$	FLUORIDE Dosage	FLUORIDE Residual
1	3.5					1.07	.98
2	3.6					1.06	.96
3	4.2					1.08	.92
4	3.4					1.11	1.04
5	3.4					1.09	1.13
6	3.4					.96	1.12
7	4.6					.85	1.08
8	4.8					.87	1.13
9	4.8					.84	1.00
10	4.8					.88	.88
11	4.8					.90	1.20
12	4.9					.69	.90
13	4.6					.69	.93
14	4.7					.99	1.25
15	4.7					.83	1.15

TABLE 4.1 (cont'd.) JUNE 1984 (mg/L)

DATE	PAC	$KMnO_4$	LIME	SODA ASH	$NaHCO_3$	FLUORIDE	
						Dosage	Residual
16	4.7					.20	.60
17	4.8					–	.35
18	4.7					–	0
19	4.1					.74	.68
20	4.7					.95	.75
21	4.7					.77	1.23
22	4.7					.79	1.10
23	4.7					.92	1.03
24	4.8					.88	–
25	5.0					1.01	.97
26	4.8					.87	1.40
27	4.8					.86	1.50
28	4.8					1.05	1.38
29	3.5					1.03	1.18
30	3.4					1.04	.90
31							

TABLE 4.1: T&O CONTROL, ALKALINITY ADJ. & FLUORIDATION PROFILE JULY 1984

(mg/L)

MOE WPOS PROTOCOL

DATE	PAC	$KMnO_4$	LIME	SODA ASH	$NaHCO_3$	FLUORIDE	
						Dosage	Residual
1	3.4					1.03	.94
2	3.4					1.01	.95
3	3.4					1.20	.96
4	3.4					.78	.98
5	3.4					.92	.98
6	3.2					1.10	.95
7	3.5					1.23	.88
8	3.4					.87	1.00
9	2.7					1.06	.95
10	0.5					1.15	1.16
11	1.9					.92	.92
12	2.8					.85	1.10
13	2.7					1.07	1.35
14	2.8					1.12	.50
15	2.8					1.01	1.03

TABLE 4.1 (cont'd.) JULY 1984 (mg/L)

DATE	PAC	$KMnO_4$	LIME	SODA ASH	$NaHCO_3$	FLUORIDE Dosage	FLUORIDE Residual
16	2.7					.89	1.30
17	2.8					.60	.55
18	2.8					.76	.92
19	2.8					.82	1.55
20	2.8					.95	1.05
21	2.8					1.03	1.13
22	2.8					1.03	1.12
23	2.8					.88	.94
24	2.8					.64	.80
25	2.8					1.07	1.19
26	2.8					.83	1.01
27	2.8					.87	.97
28	2.8					1.00	.89
29	2.7					1.18	.97
30	2.8					1.10	.92
31	2.8					1.44	1.02

TABLE 4.1: T&O CONTROL, ALKALINITY ADJ. & FLUORIDATION PROFILE AUGUST 1984

(mg/L)

MOE WPOS PROTOCOL

DATE	PAC	$KMnO_4$	LIME	SODA ASH	$NaHCO_3$	FLUORIDE Dosage	FLUORIDE Residual
1	2.8					1.59	.96
2	2.8					1.81	1.23
3	2.6					1.68	1.40
4	2.8					1.26	1.75
5	2.2					1.29	1.85
6	3.0					1.36	1.12
7	2.8					1.41	1.12
8	2.9					1.30	1.22
9	2.8					.95	1.35
10	4.1					.96	1.12
11	8.5					.86	1.20
12	12.0					.92	1.14
13	13.0					.99	1.25
14	20.8					1.19	1.05
15	35.8					1.31	1.23

TABLE 4.1 (cont'd.) AUGUST 1984 (mg/L)

DATE	PAC	$KMnO_4$	LIME	SODA ASH	$NaHCO_3$	FLUORIDE	
						Dosage	Residual
16	36.7					1.51	1.40
17	34.3					1.29	1.42
18	30.7					1.13	1.31
19	21.5					1.41	1.42
20	20.5					1.21	1.42
21	18.6					.87	.99
22	15.6					1.34	1.28
23	12.6					1.21	1.20
24	10.3					1.31	1.20
25	9.6					1.47	1.32
26	9.0					1.35	1.18
27	9.9					1.18	1.33
28	10.1					1.14	1.00
29	10.1					1.10	1.08
30	10.0					1.25	1.12
31	9.8					1.37	1.10

TABLE 4.1: T&O CONTROL, ALKALINITY ADJ. & FLUORIDATION PROFILE SEPTEMBER 1984 (mg/L)

MOE WPOS PROTOCOL

DATE	PAC	$KMnO_4$	LIME	SODA ASH	$NaHCO_3$	FLUORIDE Dosage	FLUORIDE Residual
1	9.6					1.36	1.08
2	9.7					1.40	1.26
3	9.8					1.14	1.03
4	9.1					1.09	1.05
5	8.8					1.12	1.13
6	9.7					1.05	1.06
7	9.7					1.06	1.15
8	9.6					1.24	1.06
9	9.7					1.25	1.25
10	9.8					1.29	1.21
11	9.8					1.27	1.43
12	6.6					1.05	1.02
13	4.5					1.25	1.36
14	4.5					1.06	1.21
15	4.4					1.41	1.18

DATE	PAC	$KMnO_4$	LIME	SODA ASH	$NaHCO_3$	FLUORIDE Dosage	FLUORIDE Residual
16	4.4					1.18	1.50
17	4.4					.94	1.31
18	4.5					1.10	1.15
19	4.4					1.10	1.30
20	4.5					1.08	.98
21	4.3					1.23	1.35
22	4.5					1.18	1.38
23	4.4					1.29	1.25
24	4.5					1.30	1.45
25	4.5					0.96	1.08
26	4.6					0.96	1.12
27	4.5					1.12	1.15
28	4.6					1.40	1.38
29	4.4					1.42	1.22
30	4.4					1.37	1.22
31							

TABLE 4.1: T&O CONTROL, ALKALINITY ADJ. & FLUORIDATION PROFILE OCTOBER 1984

(mg/L)

MOE WPOS PROTOCOL

DATE	PAC	$KMnO_4$	LIME	SODA ASH	$NaHCO_3$	FLUORIDE Dosage	FLUORIDE Residual
1	4.4					1.15	1.42
2	4.4					1.03	1.13
3	4.4					1.19	1.28
4	4.5					0.97	1.28
5	4.5					1.36	1.43
6	4.4					1.07	1.32
7	4.5					1.29	1.36
8	4.4					1.41	1.43
9	4.5					1.21	1.13
10	4.5					1.21	1.09
11	4.5					1.30	1.07
12	4.5					1.11	1.22
13	4.4					1.41	1.22
14	4.4					1.18	1.37
15	4.4					1.12	1.37

TABLE 4.1 (cont'd.) OCTOBER 1984 (mg/L)

DATE	PAC	$KMnO_4$	LIME	SODA ASH	$NaHCO_3$	FLUORIDE	
						Dosage	Residual
16	4.4					1.16	1.24
17	4.4					1.15	1.25
18	4.4					1.08	1.05
19	4.4					1.12	1.44
20	4.4					1.09	1.30
21	4.4					1.21	1.40
22	4.4					1.16	1.28
23	4.4					1.16	1.30
24	4.4					1.15	1.40
25	4.4					1.06	1.28
26	4.4					.93	1.22
27	4.5					.94	1.28
28	4.3					1.20	1.28
29	4.4					1.16	1.32
30	4.5					1.20	1.18
31	4.3					1.18	1.08

TABLE 4.1: T&O CONTROL, ALKALINITY ADJ. & FLUORIDATION PROFILE NOVEMBER 1984

(mg/L)

MOE WPOS PROTOCOL

DATE	PAC	$KMnO_4$	LIME	SODA ASH	$NaHCO_3$	FLUORIDE Dosage	FLUORIDE Residual
1	4.4					1.13	1.33
2	4.3					1.14	1.30
3	4.4					1.16	.91
4	4.3					1.16	1.27
5	4.3					1.06	.97
6	4.2					1.10	1.17
7	4.3					1.19	1.22
8	4.3					1.16	1.29
9	4.3					1.20	1.37
10	4.3					1.21	1.37
11	4.3					1.17	1.10
12	4.3					1.19	1.24
13	4.3					1.18	1.23
14	4.3					1.13	.98
15	3.6					1.17	1.26

TABLE 4.1 (cont'd.) NOVEMBER 1984 (mg/L)

DATE	PAC	$KMnO_4$	LIME	SODA ASH	$NaHCO_3$	FLUORIDE Dosage	FLUORIDE Residual
16	.3					1.15	1.19
17	1.7					1.15	1.45
18	2.1					1.63	1.35
19	1.7					1.17	1.26
20	1.8					1.16	1.24
21	1.7					1.03	1.30
22	1.5					0.93	1.04
23	1.6					1.07	1.32
24	2.1					1.04	1.26
25	1.8					.70	1.18
26	1.8					1.17	1.18
27	1.7					1.26	1.53
28	1.7					1.25	1.34
29	1.4					0.74	1.48
30	1.5					1.29	1.38
31							

TABLE 4.1: T&O CONTROL, ALKALINITY ADJ. & FLUORIDATION PROFILE DECEMBER 1984 (mg/L)

MOE WPOS PROTOCOL

DATE	PAC	$KMnO_4$	LIME	SODA ASH	$NaHCO_3$	FLUORIDE Dosage	FLUORIDE Residual
1	1.7					1.28	1.45
2	1.7					1.22	1.42
3	1.9					1.10	1.03
4	1.8					1.12	1.35
5	1.2					1.12	1.23
6	1.7					1.10	1.15
7	1.8					1.10	1.23
8	1.7					1.09	1.08
9	2.2					1.33	1.38
10	1.8					1.26	1.26
11	1.8					1.15	1.23
12	1.6					1.12	1.35
13	1.7					1.15	1.18
14	1.6					1.13	1.33
15	1.6					1.15	1.29

TABLE 4.1 (cont'd.) DECEMBER 1984 (mg/L)

DATE	PAC	$KMnO_4$	LIME	SODA ASH	$NaHCO_3$	FLUORIDE	
						Dosage	Residual
16	1.9					1.13	1.33
17	1.6					1.19	1.16
18	1.6					1.19	.82
19	1.6					1.19	1.38
20	1.6					1.22	1.37
21	1.6					1.20	1.30
22	1.6					1.20	1.28
23	1.2					.83	1.00
24	–					1.17	1.05
25	–					1.11	1.28
26	–					1.32	1.20
27	–					1.37	1.19
28	–					1.18	1.30
29	–					1.24	1.30
30	–					1.44	1.36
31	–					1.35	1.19

TABLE 5

WATER PLANT OPTIMIZATION STUDY

"WATER QUALITY SUMMARY"

TABLE 5.0: PLANT ST. THOMAS WPOS WATER QUALITY - 1-YEAR SUMMARY

GENERAL CHEMISTRY			1 9 86												DWSP DETECTION LIMIT*	DRINKING WATER OBJ/ GUIDELINE[1]
			JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC		
GENERAL CHEMISTRY																
ALKALINITY		R	96	–	–	–	99	102	105	101	101	–	–	–	0.2	
	mg/L	T	90	–	–	–	–	–	91	–	–	–	90	92	mg/L	
AMMONIA	TOTAL	R	.012	.020	.026	.027	.023	.065	.037	.019	0.025	0.008	0.011	0.008	0.05	
	mg/L	T	.005	–	–	–	–	–	.005	–	–	–	0.005	0.005	mg/L	
CALCIUM		R	–	–	–	–	–	–	–	–	–	–	–	–	0.1	
	mg/L	T	34.5	–	–	–	–	–	–	–	–	–	35.0	38.0	mg/L	
CHLORIDE		R	15	15	15	15	14	14	15	15	15	15	14	15	0.2	250
	mg/L	T	15	–	–	–	–	–	18	–	–	–	14	16	mg/L	mg/L
COLOUR	HzU	R	3.0	3.0	3.5	12.5	–	–	9.5	9.5	3.0	–	17.0	36.5	0.5	5
		T	1.0	1.0	1.0	1.0	1.0	–	1.0	1.0	1.0	–	1.0	1.0	TCU	TCU
CONDUCTIVITY		R	290	292	285	288	287	294	306	297	286	281	268	279	0.01	
	umho/cm	T	288	–	–	–	–	–	326	–	–	–	286	311	UMHO/CM	
FIELD CHLORINE (COMBINED)		R													0.1	
	mg/L	T													mg/L	
FIELD CHLORINE (FREE)		R													0.1	
	mg/L	T													mg/L	
FIELD CHLORINE (TOTAL)		R													0.1	
	mg/L	T													mg/L	
FIELD PH		R													0.2	
		T														

TABLE 5.0: (cont'd.)

GENERAL CHEMISTRY (Cont'd)		19 86												DWSP DETECTION LIMIT*	DRINKING WATER OBJ/ GUIDELINE[1]
		JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC		
FIELD TEMPERATURE	R														
°C	T														
FIELD TURBIDITY	R														1 FTU
FTU	T														
FLUORIDE	R	0.2	0.1	0.1	0.1	0.1	–	0.2	0.1	0.1	–	0.14	0.10	0.01	2.4
mg/L	T	1.32	1.27	1.32	1.25	1.25	1.24	1.17	1.17	1.13	1.14	1.19		mg/L	mg/L
HARDNESS	R	121	–	–	–	120	123	125	124	130	–	–	–	0.5	
mg/L	T	124	–	–	–	–	–	130	–	–	–	118	130	mg/L	
MAGNESIUM	R	–	–	–	–	–	–	–	–	–	–	–	–	0.05	
mg/L	T	8.4	–	–	–	–	–	–	–	–	–	–	–	mg/L	c
NITRATE	R	0.25	0.42	0.34	0.40	0.14	0.23	0.29	0.23	0.17	0.25	0.16	0.17	0.05	10 mg/L
mg/L	T	0.20	–	–	–	–	–	0.30	–	–	–	0.10	0.30	mg/L	as N
NITRITE	R	.004	.004	.004	.009	.010	.021	.017	.014	0.013	0.006	0.010	0.012	0.005	1 mg/L
mg/L	T	0.01	–	–	–	–	–	0.01	–	–	–	0.010	0.010	mg/L	as N
NITROGEN TOTAL KJELDAHL	R	0.28	0.35	0.36	0.29	0.26	0.53	0.32	0.36	0.43	0.37	0.35	0.37	0.1	0.15
mg/L	T												0.12	mg/L	mg/L *
PH	R	8.2	8.3	8.2	8.1	8.1	7.8	7.8	7.8	8.0	8.1	8.2	8.1		
	T	7.6	7.6	7.5	7.5	7.5	7.4	7.3	7.3	7.3	7.4	7.4	7.4		
PHOSPHORUS FILTERED REACTIVE	R													0.01	
mg/L	T													mg/L	

TABLE 5.0: (cont'd.)

GENERAL CHEMISTRY (Cont'd)		1986 JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	DWSP DETECTION LIMIT*	DRINKING WATER OBJ/ GUIDELINE[1]
PHOSPHORUS TOTAL	R	.026	.024	.021	.033	.025	.047	.047	.046	.078	.045	.062	.070	0.01	
mg/L	T													mg/L	
SODIUM	R													0.1	
mg/L	T													mg/L	
TOTAL SOLIDS	R													1	
mg/L	T													mg/L	
TURBIDITY	R	13.3	6.5	29.5	21.6	15.8	29.1	26.8	16.5	33.5	50.1	49.3	89.7	0.01	1
FTU	T	0.13	0.17	0.12	0.07	0.08	0.10	0.08	0.09	0.10	0.09	0.09	0.09	FTU	FTU
METALS															
ALUMINUM	R	—												0.003	
mg/L	T	.02	.02	.02	.01	.03	.02	.03	.03	.02	.02	.02	.01	mg/L	
ARSENIC	R													0.001	0.05
mg/L	T													mg/L	mg/L
BARIUM	R													0.001	1
mg/L	T													mg/L	mg/L
BERYLLIUM	R													0.001	
mg/L	T													mg/L	
BORON	R													0.02	5
mg/L	T													mg/L	mg/L
CADMIUM	R													0.0003	0.005
mg/L	T													mg/L	mg/L

TABLE 5.0: (cont'd.)

METALS (Cont'd)			19 86 JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	DWSP DETECTION LIMIT*	DRINKING WATER OBJ/ GUIDELINE[1]
CHROMIUM		R													0.001	0.05
	mg/L	T													mg/L	mg/L
COBALT		R													0.001	
	mg/L	T													mg/L	
COPPER		R													0.001	1
	mg/L	T													mg/L	mg/L
CYANIDE		R													0.001	0.2
	mg/L	T													mg/L	mg/L
IRON		R	0.19	0.17	0.08	1.00	0.58	-	0.68	0.48	0.68	-	1.02	5.45	0.002	0.3
	mg/L	T	0.01	0.05	0.01	0.01	0.02	-	0.01	0.01	0.01	-	0.01	0.02	mg/L	mg/L c
LEAD	mg/L	R													0.003	0.05
		T													mg/L	mg/L
MANGANESE		R													0.001	0.05
	mg/L	T													mg/L	mg/L
MOLYBDENUM		R													0.001	
	mg/L	T													mg/L	
MERCURY		R													0.01	1
	ug/L	T													ug/L	ug/L
NICKEL		R													0.002	
	mg/L	T													mg/L	

TABLE 5.0: (cont'd.)

METALS (Cont'd)		19 86 JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	DWSP DETECTION LIMIT*	DRINKING WATER OBJ/ GUIDELINE[1]
SELENIUM	R													0.001	0.01
mg/L	T													mg/L	mg/L
STRONTIUM	R													0.001	
mg/L	T													mg/L	
TIN	R														
(no units available)	T														
URANIUM	R													0.002	.02
mg/L	T													mg/L	mg/L t
VANADIUM	R													0.001	
mg/L	T													mg/L	
ZINC	R													0.001	5
mg/L	T													mg/L	mg/L h
PURGEABLES															
BENZENE	R													1	10
ug/L	T													ug/L	ug/L h
BROMOFORM	R													1	350
ug/L	T													ug/L	ug/L ++
CARBON TETRACHLORIDE	R													1	3
ug/L	T													ug/L	ug/L h
CHLOROBENZENE	R													1	100-300
ug/L	T													ng/L	ng/L h*

TABLE 5.0: (cont'd.)

PURGEABLES (Cont'd)		19 86												DWSP DETECTION LIMIT*	DRINKING WATER OBJ/ GUIDELINE[1]
		JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC		
CHLORODIBROMOMETHANE	R	–												1	350
ug/L	T	5	5	4	4	6	7	3	5	6	4	4	4	ug/L	ug/L ++
CHLOROFORM	R	–												1	350
ug/L	T	26	32	24	23	47	12	14	17	51	15	22	14	ug/L	ug/L ++
1,2-DICHLOROBENZENE	R													1	400
ug/L	T													ug/L	ug/L e
1,3-DICHLOROBENZENE	R													1	400
ug/L	T													ug/L	ug/L e
1,4-DICHLOROBENZENE	R													1	400
ug/L	T													ug/L	ug/L e
DICHLOROBROMOMETHANE	R	–												1	350
ug/L	T	12	13	11	11	13	16	5	13	17	7	10	9	ug/L	ug/L ++
1,1-DICHLOROETHANE	R													1	
ug/L	T													ug/L	
1,2-DICHLOROETHANE	R													1	10
ug/L	T													ug/L	ug/L h
1,1-DICHLOROETHYLENE	R													1	.3
ug/L	T													ug/L	ug/L h
T,1,2-DICHLOROETHYLENE	R													1	
ug/L	T													ug/L	

TABLE 5.0: (cont'd.)

PURGEABLES (Cont'd)		1 9 86												DWSP DETECTION LIMIT*	DRINKING WATER OBJ/ GUIDELINE[1]
		JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC		
DICHLOROMETHANE	R													5	40
ug/L	T													ug/L	ug/L c
1,2 DICHLOROPROPANE	R													1	
ug/L	T													ug/L	
ETHYLBENZENE	R													1	1400
ug/L	T													ug/L	ug/L e
ETHYLENE DIBROMIDE	R														
ug/L	T														
M-XYLENE	R													1	620
ug/L	T													ug/L	ug/L c
O-XYLENE	R													1 ug/L	620
ug/L	T														ug/L c
P-XYLENE	R													1	620
ug/L	T													ug/L	ug/L c
TOLUENE	R													1	100
ug/L	T													ug/L	ug/L c
1,1,2,2-TETRACHLOROETHANE	R													1	1.7
ug/L	T													ug/L	ug/L e
TETRACHLOROETHYLENE	R													1	10
ug/L	T													ug/L	ug/L h

TABLE 5.0: (cont'd.)

PURGEABLES (Cont'd)		19 86 JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	DWSP DETECTION LIMIT*	DRINKING WATER OBJ/ GUIDELINE[1]
1,1,1-TRICHLOROETHANE	R													1	1000
ug/L	T													ug/L	ug/L c
1,1,2-TRICHLOROETHANE	R													1	6
ug/L	T													ug/L	ug/L e
TRICHLOROETHYLENE	R													1	30
ug/L	T													ug/L	ug/L h
TOTAL TRIHALOMETHANES	R	–												3	350
ug/L	T	43	50	39	38	66	35	22	35	74	26	36	27	ug/L	ug/L ++
TRIFLUOROCHLOROTOLUENE	R													1	
ug/L	T													ug/L	
ORGANOCHLORINES															
ALDRIN	R													1	700
ng/L	T													ng/L	ng/L **
ALPHA BHC	R													1	700
ng/L	T													ng/L	ng/L c
ALPHA CHLORDANE	R													2	700
ng/L	T													ng/L	ng/L ***
BETA BHC	R													1	300
ng/L	T													ng/L	ng/L c
DIELDRIN	R													2	700
ng/L	T													ng/L	ng/L **

TABLE 5.0: (cont'd.)

ORGANOCHLORINES (Cont'd)		19 86 JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	DWSP DETECTION LIMIT*	DRINKING WATER OBJ/ GUIDELINE[1]
ENDRIN	R													4	200
ng/L	T													ng/L	ng/L
GAMMA CHLORDANE	R													2	700
ng/L	T													ng/L	ng/L ***
HEPTACHLOR EPOXIDE	R													1	3000 +++
ng/L	T													ng/L	ng/L
HEPTACHLOR	R													1	3000
ng/L	T													ng/L	ng/L +++
HEXACHLOROBENZENE	R													1	10
ng/L	T													ng/L	ng/L h
HEXACHLOROBUTADIENE	R														
ug/L	T														
HEXACHLOROETHANE	R													1	19000
ng/L	T													ng/L	ng/L e
LINDANE	R													1	4000
ng/L	T													ng/L	ng/L
METHOXYCHLOR	R													5	100000
ng/L	T													ng/L	ng/L
MIREX	R													5	
ng/L	T													ng/L	

TABLE 5.0: (cont'd.)

ORGANOCHLORINES (Cont'd)		19 86												DWSP DETECTION LIMIT*	DRINKING WATER OBJ/ GUIDELINE[1]
		JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC		
OCTACHLOROSTYRENE	R													1	
ng/L	T													ng/L	
O,P-DDT	R													5	30000
ng/L	T													ng/L	ng/L d
OXYCHLORDANE	R													2	
ng/L	T													ng/L	
PCB TOTAL	R													20	3000
ng/L	T													ng/L	ng/L t
PENTACHLOROBENZENE	R													1	74000
ng/L	T													ng/L	ng/L e
P,P-DDD	R													5	d
ng/L	T													ng/L	
P,P-DDE	R													1	d
ng/L	T													ng/L	
P,P-DDT	R													5	d
ng/L	T													ng/L	
1,2,3,4-TETRACHLOROBENZENE	R													1	
ng/L	T													ng/L	
1,2,3,5-TETRACHLOROBENZENE	R													1	
ng/L	T													ng/L	

TABLE 5.0: (cont'd.)

ORGANOCHLORINES (Cont'd)		19 86 JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	DWSP DETECTION LIMIT*	DRINKING WATER OBJ/ GUIDELINE[1]
1,2,4,5-TETRACHLOROBENZENE	R													1	38000
ng/L	T													ng/L	ng/L e
THIODAN I	R													2	74000
ng/L	T													ng/L	ng/L ea
THIODAN II	R													4	74000
ng/L	T													ng/L	ng/L ea
THIODAN SULPHATE	R													4	
ng/L	T													ng/L	
TOXAPHENE	R														
(no units available)	T														
1,2,3-TRICHLOROBENZENE	R													5	10000
ng/L	T													ng/L	ng/L y
1,2,4-TRICHLOROBENZENE	R													5	15000
ng/L	T													ng/L	ng/L y
1,3,5-TRICHLOROBENZENE	R													5	10000
ng/L	T													ng/L	ng/L y
2,3,6-TRICHLOROTOLUENE	R													5	
ng/L	T													ng/L	
2,4,5-TRICHLOROTOLUENE	R													5	10000
ng/L	T													ng/L	ng/L g

TABLE 5.0: (cont'd.)

ORGANOCHLORINES (Cont'd)		JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	DWSP DETECTION LIMIT*	DRINKING WATER OBJ/ GUIDELINE[1]
							19 86								
2,6,A-TRICHLOROTOLUENE	R													5	
mg/L	T													ng/L	
TRIAZINES															
ALACHLOR	R														
ng/L	T														
AMETRINE	R									<50				50	
ng/L	T													ng/L	
ATRATONE	R									<50					
ng/L	T														
ATRAZINE	R													50	46000
ng/L	T													ng/L	ng/L 1
BLADEX	R									<100				100	10000
ng/L	T													ng/L	ng/L 1
METOLACHLOR	R									<500					
ng/L	T														
PROMETONE	R									<50				50	
ng/L	T													ng/L	
PROMETRYNE	R									<50				50	1000
ng/L	T													ng/L	ng/L 1
PROPAZINE	R									<50				50	
ng/L	T													ng/L	

TABLE 5.0: (cont'd.)

TRIAZINES (Cont'd)		1 9 86 JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	DWSP DETECTION LIMIT*	DRINKING WATER OBJ/ GUIDELINE[1]
SENCOR	R									<100				100	
ng/L	T													ng/L	
SIMAZINE	R									<50				50	10000
ng/L	T													ng/L	ng/L I
SPECIAL PESTICIDES															
2,4-D	R													100	100000
ng/L	T													ng/L	ng/L
2,4-D BUTYRIC ACID	R													200	18000
ng/L	T													ng/L	ng/L I
DICAMBA	R													100	87000
ng/L	T													ng/L	ng/L I
PENTACHLOROPHENOL	R													50	10000
ng/L	T													ng/L	ng/L h
PICLORAM	R													100	
ng/L	T													ng/L	
2,4-D PROPIONIC ACID	R													100	
ng/L	T													ng/L	
SILVEX	R													50	10000
ng/L	T													ng/L	ng/L
2,4,5-T	R													50	
ng/L	T													ng/L	

TABLE 5.0: (cont'd.)

SPECIAL PESTICIDES (Cont'd)		1 9 86												DWSP DETECTION LIMIT*	DRINKING WATER OBJ/ GUIDELINE[1]
		JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC		
2,3,4,5-TETRACHLOROPHENOL	R													50	
ng/L	T													ng/L	
2,3,5,6-TETRACHLOROPHENOL	R													50	
ng/L	T													ng/L	
2,3,4-TRICHLOROPHENOL	R													100	
ng/L	T													ng/L	
2,4,5-TRICHLOROPHENOL	R													50	
ng/L	T													ng/L	
2,4,6-TRICHLOROPHENOL	R													50	10000
ng/L	T													ng/L	ng/L h
ORGANOPHOSPHOROUS PESTICIDES															
DIAZINON	R													50	14000
ng/L	T													ng/L	ng/L
DICHLOROVOS	R														
ng/L	T														
DURSBAN	R														
ng/L	T														
ETHION	R														
ng/L	T														
GUTHION	R														
ng/L	T														

TABLE 5.0: (cont'd.)

ORGANOPHOSPHOROUS PESTICIDES (Cont'd)		1 9 86												DWSP DETECTION LIMIT*	DRINKING WATER OBJ/ GUIDELINE[1]
		JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC		
MALATHION	R														
ng/L	T														
METHYLPARATHION	R													50	7000
ng/L	T													ng/L	ng/L
METHYLTRITHION	R														
ng/L	T														
MEVINPHOS	R														
ng/L	T														
PARATHION	R													50	35000
ng/L	T													ng/L	ng/L
PHORBATE	R														
ng/L	T														
RELDAN	R														
ng/L	T														
RONNEL	R														
ng/L	T														
MASS SPEC.															
DI-N-BUTYL PHTHALATE	R													0.1	34000
ug/L	T													ug/L	ug/L e

TABLE 5.0: (cont'd.)

MASS SPEC. (Cont'd)		19 86 JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	DWSP DETECTION LIMIT*	DRINKING WATER OBJ/ GUIDELINE[1]
N-DICHLOROMETHYLENE- PENTACHLOROANALINE ug/L	R T													0.1 ug/L	
DIPHENYL ETHER ug/L	R T													0.1 ug/L	
FLUORANTHENE ug/L	R T													0.1 ug/L	
HEXACHLOROPROPENE ug/L	R T													0.1 ug/L	
METHYL PHENANTHRENE ug/L	R T													0.1 ug/L	
NAPHTHALENE ug/L	R T													0.1 ug/L	
PENTACHLOROBUTADIENE ug/L	R T													0.1 ug/L	
PENTACHLOROPROPANE ug/L	R T													0.1 ug/L	
PENTACHLOROPROPENE ug/L	R T													0.1 ug/L	
PYRENE ug/L	R T													0.1 ug/L	

TABLE 5.0: (cont'd.)

MASS SPEC. (Cont'd)		JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	DWSP DETECTION LIMIT*	DRINKING WATER OBJ/ GUIDELINE[1]
		19 86													
TETRACHLORBUTANE ug/L	R T													0.1 ug/L	
TETRACHLOROBIPHENYL ug/L	R T													0.1 ug/L	
BACTERIA (1)															
RAW WATER:															
TOTAL COLIFORM 0-100/100 mL	R	8	8	7	8	9	9	9	7	8	7	8	7		
101-5000/100 mL	R	1		1	1				1	1	2		1		
TOTAL COLIFORM BKGD count/mL	R														
FECAL COLIFORM 0-10/100 mL	R	6	8	7	9	8	9	9	8	9	8	8	8	0	0/0.1 mL
STANDARD PLATE COUNT MF count/100mL	R													0	500
TREATED WATER:															
PRESENT/ABSENT TEST - P/A	A T	16	14	16	18	16	18	18	16	16	18	17	15		
	P T			2						1					
TOTAL COLIFORM BACKGROUND MF count/100mL	T													0	OWDO Bacti

(1) Number of tests done per month

TABLE 5.0: (cont'd.)

BACTERIA (Cont'd)		19 86												DWSP DETECTION LIMIT*	DRINKING WATER OBJ/ GUIDELINE[1]
		JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC		
TREATED WATER: (Cont'd)															
FECAL COLIFORM MF count/100 mL	T													0	ODWO Bacti
STANDARD PLATE COUNT MF 0-500/mL	T	2	3	6	2	2	3	1	1	5	3	2	5		
>500/mL		0	0	0	0	0	0	0	0	1	0	0	0		
IF PRESENT/ABSENT TEST POSITIVE:															
Total Coliform 1-4/100 mL	T			2						1					
FECAL COLIFORM P/A	T														
E. COLI P/A	T														
AROMONAS P/A	T														
STAPH. AUREUS P/A	T														

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TABLE 5.0: PLANT ST. THOMAS

MPOS
WATER QUALITY - 1-YEAR SUMMARY

GENERAL CHEMISTRY			19 85												DWSP DETECTION LIMIT*	DRINKING WATER OBJ/ GUIDELINE[1]
			JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC		
GENERAL CHEMISTRY																
ALKALINITY		R	99	–	–	–	124	95	–	–	–	–	–	–	0.2	
	mg/L	T	88	–	–	–	–	–	73	–	–	–	–	–	mg/L	
AMMONIA	TOTAL	R	.023	.009	.044	.042	.026	.036	.072	.036	.036	.024	.025	.028	0.05	
	mg/L	T	.005	–	–	–	–	–	.005	–	–	–	–	–	mg/L	
CALCIUM		R													0.1	
	mg/L	T													mg/L	
CHLORIDE		R	14	16	14	14	14	15	15	14	14	14	15	15	0.2	250
	mg/L	T	16	–	–	–	–	–	16	–	–	–	–	–	mg/L	mg/L
COLOUR	HzU	R	7	–	–	–	6.5	1	–	–	–	–	–	–	0.5	5
		T	1	1	1	1	2	1	1	1	1	1	1	1	TCU	TCU
CONDUCTIVITY		R	287	302	268	289	284	289	298	281	297	289	282	289	0.01	
	umho/cm	T	288	–	–	–	–	–	288	–	–	311	–	–	UMHO/CM	
FIELD CHLORINE (COMBINED)		R													0.1	
	mg/L	T													mg/L	
FIELD CHLORINE (FREE)		R													0.1	
	mg/L	T													mg/L	
FIELD CHLORINE (TOTAL)		R													0.1	
	mg/L	T													mg/L	
FIELD PH		R													0.2	
		T														

TABLE 5.0: (cont'd.)

GENERAL CHEMISTRY (Cont'd)		19 85 JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	DWSP DETECTION LIMIT*	DRINKING WATER OBJ/ GUIDELINE[1]
FIELD TEMPERATURE	R														
°C	T														
FIELD TURBIDITY	R														1 FTU
FTU	T														
FLUORIDE	R	0.13	–	–	–	–	–	–	–	–	–	–	–	0.01	2.4
mg/L	T	1.30	1.27	1.18	1.15	1.24	1.22	1.20	1.38	1.39	1.32	1.25	1.28	mg/L	mg/L
HARDNESS	R	127	–	–	–	–	–	–	–	–	–	–	–	0.5	
mg/L	T	123	–	–	–	–	–	110	–	–	–	–	–	mg/L	
MAGNESIUM	R													0.05	
mg/L	T													mg/L	c
NITRATE	R	.25	.24	.49	.56	.27	.24	.25	.21	.16	.12	.36	.27	0.05	10 mg/L
mg/L	T	.29	–	–	–	–	–	.24	–	–	–	–	–	mg/L	as N
NITRITE	R	.006	.003	.015	.010	.004	.005	.015	.015	.010	.006	.015	.009	0.005	1 mg/L
mg/L	T	.001	–	–	–	–	–	.001	–	–	–	–	–	mg/L	as N
NITROGEN TOTAL KJELDAHL	R	0.43	.26	.34	.45	.38	.39	.56	.42	.43	.39	.37	.41	0.1	0.15
mg/L	T													mg/L	mg/L *
PH	R	8.0	8.1	8.0	8.1	8.2	7.9	7.7	7.9	7.9	8.1	8.2	8.2		
	T	7.3	7.5	7.3	7.4	7.5	7.3	7.2	7.3	7.3	7.4	7.5	7.6		
PHOSPHORUS FILTERED REACTIVE	R													0.01	
mg/L	T													mg/L	

TABLE 5.0: (cont'd.)

GENERAL CHEMISTRY (Cont'd)		19 85 JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	DWSP DETECTION LIMIT*	DRINKING WATER OBJ/ GUIDELINE[1]
PHOSPHORUS TOTAL	R	.076	.017	.050	.116	.057	.033	.032	.048	.028	.049	.129	.097	0.01	
mg/L	T	–												mg/L	
SODIUM	R													0.1	
mg/L	T													mg/L	
TOTAL SOLIDS	R													1	
mg/L	T													mg/L	
TURBIDITY	R	54	6.3	56.6	89.6	18.2	21.4	19	20.5	24.7	53.6	91.5	81.9	0.01	1
FTU	T	.18	.19	.21	.16	.14	.14	.14	.16	.16	.14	.13	.12	FTU	FTU
METALS															
ALUMINUM	R	–												0.003	
mg/L	T	.01	.02	.01	.01	.01	.01	.01	.02	.01	.03	.03	.01	mg/L	
ARSENIC	R													0.001	0.05
mg/L	T													mg/L	mg/L
BARIUM	R													0.001	1
mg/L	T													mg/L	mg/L
BERYLLIUM	R													0.001	
mg/L	T													mg/L	
BORON	R													0.02	5
mg/L	T													mg/L	mg/L
CADMIUM	R													0.0003	0.005
mg/L	T													mg/L	mg/L

TABLE 5.0: (cont'd.)

METALS (Cont'd)			19 85												DWSP DETECTION LIMIT*	DRINKING WATER OBJ/ GUIDELINE[1]
			JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC		
CHROMIUM		R													0.001	0.05
	mg/L	T													mg/L	mg/L
COBALT		R													0.001	
	mg/L	T													mg/L	
COPPER		R													0.001	1
	mg/L	T													mg/L	mg/L
CYANIDE		R													0.001	0.2
	mg/L	T													mg/L	mg/L
IRON		R	1.6	–	–	–	–	–	–	–	–	–	–	–	0.002	0.3
	mg/L	T	0.01	0.01	0.02	0.01	0.04	0.01	0.01	0.04	0.01	0.03	0.04	0.01	mg/L	mg/L c
LEAD	mg/L	R													0.003	0.05
		T													mg/L	mg/L
MANGANESE		R													0.001	0.05
	mg/L	T													mg/L	mg/L
MOLYBDENUM		R													0.001	
	mg/L	T													mg/L	
MERCURY		R													0.01	1
	ug/L	T													ug/L	ug/L
NICKEL		R													0.002	
	mg/L	T													mg/L	

TABLE 5.0: (cont'd.)

METALS (Cont'd)		19 85 JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	DWSP DETECTION LIMIT*	DRINKING WATER OBJ/ GUIDELINE[1]
SELENIUM	R													0.001	0.01
mg/L	T													mg/L	mg/L
STRONTIUM	R													0.001	
mg/L	T													mg/L	
TIN	R														
(no units available)	T														
URANIUM	R													0.002	.02
mg/L	T													mg/L	mg/L t
VANADIUM	R													0.001	
mg/L	T													mg/L	
ZINC	R													0.001	5
mg/L	T													mg/L	mg/L h
PURGEABLES															
BENZENE	R													1	10
ug/L	T													ug/L	ug/L h
BROMOFORM	R													1	350
ug/L	T													ug/L	ug/L ++
CARBON TETRACHLORIDE	R													1	3
ug/L	T													ug/L	ug/L h
CHLOROBENZENE	R													1	100-300
ug/L	T													ng/L	ng/L h*

TABLE 5.0: (cont'd.)

PURGEABLES (Cont'd)		19 85 JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	DWSP DETECTION LIMIT*	DRINKING WATER OBJ/ GUIDELINE[1]
CHLORODIBROMOMETHANE	R	–												1	350
ug/L	T	5	6	5	5	5	5	6	6	5	6	6	5	ug/L	ug/L ++
CHLOROFORM	R	–												1	350
ug/L	T	31	31	38	29	40	16	26	34	33	35	32	22	ug/L	ug/L ++
1,2-DICHLOROBENZENE	R													1	400
ug/L	T													ug/L	ug/L e
1,3-DICHLOROBENZENE	R													1	400
ug/L	T													ug/L	ug/L e
1,4-DICHLOROBENZENE	R													1	400
ug/L	T													ug/L	ug/L e
DICHLOROBROMOMETHANE	R	–												1	350
ug/L	T	14	16	16	15	15	14	14	16	20	18	16	12	ug/L	ug/L ++
1,1-DICHLOROETHANE	R													1	
ug/L	T													ug/L	
1,2-DICHLOROETHANE	R													1	10
ug/L	T													ug/L	ug/L h
1,1-DICHLOROETHYLENE	R													1	.3
ug/L	T													ug/L	ug/L h
T,1,2-DICHLOROETHYLENE	R													1	
ug/L	T													ug/L	

TABLE 5.0: (cont'd.)

PURGEABLES (Cont'd)		19 85 JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	DWSP DETECTION LIMIT*	DRINKING WATER OBJ/ GUIDELINE[1]
DICHLOROMETHANE	R													5	40
ug/L	T													ug/L	ug/L c
1,2 DICHLOROPROPANE	R													1	
ug/L	T													ug/L	
ETHYLBENZENE	R													1	1400
ug/L	T													ug/L	ug/L e
ETHYLENE DIBROMIDE	R														
ug/L	T														
M-XYLENE	R													1	620
ug/L	T													ug/L	ug/L c
O-XYLENE	R													1 ug/L	620
ug/L	T														ug/L c
P-XYLENE	R													1	620
ug/L	T													ug/L	ug/L c
TOLUENE	R													1	100
ug/L	T													ug/L	ug/L c
1,1,2,2-TETRACHLOROETHANE	R													1	1.7
ug/L	T													ug/L	ug/L e
TETRACHLOROETHYLENE	R													1	10
ug/L	T													ug/L	ug/L h

TABLE 5.0: (cont'd.)

PURGEABLES (Cont'd)		1 9 85												DWSP DETECTION LIMIT*	DRINKING WATER OBJ/ GUIDELINE[1]
		JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC		
1,1,1-TRICHLOROETHANE	R													1	1000
ug/L	T													ug/L	ug/L c
1,1,2-TRICHLOROETHANE	R													1	6
ug/L	T													ug/L	ug/L e
TRICHLOROETHYLENE	R													1	30
ug/L	T													ug/L	ug/L h
TOTAL TRIHALOMETHANES	R	–												3	350
ug/L	T	50	53	59	49	60	35	46	56	58	59	54	39	ug/L	ug/L ++
TRIFLUOROCHLOROTOLUENE	R													1	
ug/L	T													ug/L	
ORGANOCHLORINES															
ALDRIN	R													1	700
ng/L	T													ng/L	ng/L **
ALPHA BHC	R													1	700
ng/L	T													ng/L	ng/L c
ALPHA CHLORDANE	R													2	700
ng/L	T													ng/L	ng/L ***
BETA BHC	R													1	300
ng/L	T													ng/L	ng/L c
DIELDRIN	R													2	700
ng/L	T													ng/L	ng/L **

TABLE 5.0: (cont'd.)

ORGANOCHLORINES (Cont'd)		19 85 JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	DWSP DETECTION LIMIT*	DRINKING WATER OBJ/ GUIDELINE[1]
ENDRIN	R													4	200
ng/L	T													ng/L	ng/L
GAMMA CHLORDANE	R													2	700
ng/L	T													ng/L	ng/L ***
HEPTACHLOR EPOXIDE	R													1	3000 +++
ng/L	T													ng/L	ng/L
HEPTACHLOR	R													1	3000
ng/L	T													ng/L	ng/L +++
HEXACHLOROBENZENE	R													1	10
ng/L	T													ng/L	ng/L h
HEXACHLOROBUTADIENE	R														
ug/L	T														
HEXACHLOROETHANE	R													1	19000
ng/L	T													ng/L	ng/L e
LINDANE	R													1	4000
ng/L	T													ng/L	ng/L
METHOXYCHLOR	R													5	100000
ng/L	T													ng/L	ng/L
MIREX	R													5	
ng/L	T													ng/L	

TABLE 5.0: (cont'd.)

ORGANOCHLORINES (Cont'd)		19 85												DWSP DETECTION LIMIT*	DRINKING WATER OBJ/ GUIDELINE[1]
		JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC		
OCTACHLOROSTYRENE	R													1	
ng/L	T													ng/L	
O,P-DDT	R													5	30000
ng/L	T													ng/L	ng/L d
OXYCHLORDANE	R													2	
ng/L	T													ng/L	
PCB TOTAL	R													20	3000
ng/L	T													ng/L	ng/L t
PENTACHLOROBENZENE	R													1	74000
ng/L	T													ng/L	ng/L e
P,P-DDD	R													5	d
ng/L	T													ng/L	
P,P-DDE	R													1	d
ng/L	T													ng/L	
P,P-DDT	R													5	d
ng/L	T													ng/L	
1,2,3,4-TETRACHLOROBENZENE	R													1	
ng/L	T													ng/L	
1,2,3,5-TETRACHLOROBENZENE	R													1	
ng/L	T													ng/L	

TABLE 5.0: (cont'd.)

ORGANOCHLORINES (Cont'd)		19 85 JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	DWSP DETECTION LIMIT*	DRINKING WATER OBJ/ GUIDELINE[1]
1,2,4,5-TETRACHLOROBENZENE	R													1	38000
ng/L	T													ng/L	ng/L e
THIODAN I	R													2	74000
ng/L	T													ng/L	ng/L ea
THIODAN II	R													4	74000
ng/L	T													ng/L	ng/L ea
THIODAN SULPHATE	R													4	
ng/L	T													ng/L	
TOXAPHENE	R														
(no units available)	T														
1,2,3-TRICHLOROBENZENE	R													5	10000
ng/L	T													ng/L	ng/L y
1,2,4-TRICHLOROBENZENE	R													5	15000
ng/L	T													ng/L	ng/L y
1,3,5-TRICHLOROBENZENE	R													5	10000
ng/L	T													ng/L	ng/L y
2,3,6-TRICHLOROTOLUENE	R													5	
ng/L	T													ng/L	
2,4,5-TRICHLOROTOLUENE	R													5	10000
ng/L	T													ng/L	ng/L g

TABLE 5.0: (cont'd.)

ORGANOCHLORINES (Cont'd)		19 85												DWSP DETECTION LIMIT*	DRINKING WATER OBJ/ GUIDELINE[1]
		JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC		
2,6,A-TRICHLOROTOLUENE	R													5	
mg/L	T													ng/L	
TRIAZINES															
ALACHLOR	R														
ng/L	T														
AMETRINE	R													50	
ng/L	T													ng/L	
ATRATONE	R														
ng/L	T														
ATRAZINE	R													50	46000
ng/L	T													ng/L	ng/L 1
BLADEX	R													100	10000
ng/L	T													ng/L	ng/L 1
METOLACHLOR	R														
ng/L	T														
PROMETONE	R													50	
ng/L	T													ng/L	
PROMETRYNE	R													50	1000
ng/L	T													ng/L	ng/L 1
PROPAZINE	R													50	
ng/L	T													ng/L	

TABLE 5.0: (cont'd.)

TRIAZINES (Cont'd)		19 85 JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	DWSP DETECTION LIMIT*	DRINKING WATER OBJ/ GUIDELINE[1]
SENCOR	R													100	
ng/L	T													ng/L	
SIMAZINE	R													50	10000
ng/L	T													ng/L	ng/L !
SPECIAL PESTICIDES															
2,4-D	R													100	100000
ng/L	T													ng/L	ng/L
2,4-D BUTYRIC ACID	R													200	18000
ng/L	T													ng/L	ng/L !
DICAMBA	R													100	87000
ng/L	T													ng/L	ng/L !
PENTACHLOROPHENOL	R													50	10000
ng/L	T													ng/L	ng/L h
PICLORAM	R													100	
ng/L	T													ng/L	
2,4-D PROPIONIC ACID	R													100	
ng/L	T													ng/L	
SILVEX	R													50	10000
ng/L	T													ng/L	ng/L
2,4,5-T	R													50	
ng/L	T													ng/L	

TABLE 5.0: (cont'd.)

SPECIAL PESTICIDES (Cont'd)		19 85 JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	DWSP DETECTION LIMIT*	DRINKING WATER OBJ/ GUIDELINE[1]
2,3,4,5-TETRACHLOROPHENOL	R													50	
ng/L	T													ng/L	
2,3,5,6-TETRACHLOROPHENOL	R													50	
ng/L	T													ng/L	
2,3,4-TRICHLOROPHENOL	R													100	
ng/L	T													ng/L	
2,4,5-TRICHLOROPHENOL	R													50	
ng/L	T													ng/L	
2,4,6-TRICHLOROPHENOL	R													50	10000
ng/L	T													ng/L	ng/L h
ORGANOPHOSPHOROUS PESTICIDES															
DIAZINON	R													50	14000
ng/L	T													ng/L	ng/L
DICHLOROVOS	R														
ng/L	T														
DURSBAN	R														
ng/L	T														
ETHION	R														
ng/L	T														
GUTHION	R														
ng/L	T														

TABLE 5.0: (cont'd.)

ORGANOPHOSPHOROUS PESTICIDES (Cont'd)		19 85 JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	DWSP DETECTION LIMIT*	DRINKING WATER OBJ/ GUIDELINE[1]
MALATHION	R														
ng/L	T														
METHYLPARATHION	R													50	7000
ng/L	T													ng/L	ng/L
METHYLTRITHION	R														
ng/L	T														
MEVINPHOS	R														
ng/L	T														
PARATHION	R													50	35000
ng/L	T													ng/L	ng/L
PHORBATE	R														
ng/L	T														
RELDAN	R														
ng/L	T														
RONNEL	R														
ng/L	T														
MASS SPEC.															
DI-N-BUTYL PHTHALATE	R													0.1	34000
ug/L	T													ug/L	ug/L e

TABLE 5.0: (cont'd.)

MASS SPEC. (Cont'd)		19 85 JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	DWSP DETECTION LIMIT*	DRINKING WATER OBJ/ GUIDELINE[1]
N-DICHLOROMETHYLENE- PENTACHLOROANALINE	R													0.1 ug/L	
ug/L	T														
DIPHENYL ETHER	R													0.1	
ug/L	T													ug/L	
FLUORANTHENE	R													0.1	
ug/L	T													ug/L	
HEXACHLOROPROPENE	R													0.1	
ug/L	T													ug/L	
METHYL PHENANTHRENE	R													0.1	
ug/L	T													ug/L	
NAPHTHALENE	R													0.1	
ug/L	T													ug/L	
PENTACHLOROBUTADIENE	R													0.1	
ug/L	T													ug/L	
PENTACHLOROPROPANE	R													0.1	
ug/L	T													ug/L	
PENTACHLOROPROPENE	R													0.1	
ug/L	T													ug/L	
PYRENE	R													0.1	
ug/L	T													ug/L	

TABLE 5.0: (cont'd.)

MASS SPEC. (Cont'd)		JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	DWSP DETECTION LIMIT*	DRINKING WATER OBJ/ GUIDELINE[1]
		19 85													
TETRACHLORBUTANE	R													0.1	
ug/L	T													ug/L	
TETRACHLOROBIPHENYL	R													0.1	
ug/L	T													ug/L	
BACTERIA (1)															
RAW WATER:															
TOTAL COLIFORM 0-100/100 mL	R	9	8	7	9	9	8	9	9	8	9	4	7		
101-5000/100 mL	R			1						1		4	1		
TOTAL COLIFORM BKGD count/mL	R														
FECAL COLIFORM 0-10/100 mL	R	9	8	8	9	7	8	9	9	9	9	7	8	0	0/0.1 mL
STANDARD PLATE COUNT MF count/100mL	R													0	500
TREATED WATER:															
PRESENT/ABSENT TEST - P/A	A T	18	16	16	17	17	16	17	16	18	18	16	15		
	P T								1						
TOTAL COLIFORM BACKGROUND MF count/100mL	T													0	OWDO Bacti

(1) Number of tests done per month

TABLE 5.0: (cont'd.)

BACTERIA (Cont'd)		19 85 JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	DWSP DETECTION LIMIT*	DRINKING WATER OBJ/ GUIDELINE[1]
TREATED WATER: (Cont'd)															
FECAL COLIFORM MF count/100 mL	T													0	ODWO Bactl
STANDARD PLATE COUNT MF 0-500/mL >500/mL	T	1	2	1	2	1	4	4	5	2	4	5	3		
IF PRESENT/ABSENT TEST POSITIVE:															
Total Coliform 1-4/100 mL	T	–	–	–	–	–	–	–	1	–	–	–	–		
FECAL COLIFORM P/A	T														
E. COLI P/A	T														
AROMONAS P/A	T														
STAPH. AUREUS P/A	T														

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TABLE 5.0: PLANT ST. THOMAS WATER QUALITY - 1-YEAR SUMMARY

GENERAL CHEMISTRY			1 9 84												DWSP DETECTION LIMIT*	DRINKING WATER OBJ/ GUIDELINE[1]
			JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC		
GENERAL CHEMISTRY																
ALKALINITY		R	106	–	–	105	–	–	–	–	–	–	–	98	0.2	
	mg/L	T	100	–	–	92	–	–	–	–	91	91	–	91	mg/L	
AMMONIA	TOTAL	R	.027	.060	.040	.043	.045	.038	.101	.038	.035	.037	.018	.020	0.05	
	mg/L	T	.005	–	0.1	.005	–	–	–	–	–	–	–	.005	mg/L	
CALCIUM		R	–												0.1	
	mg/L	T	40.5	–	–	36.0	–	–	–	–	37.0	38.0	–	36.5	mg/L	
CHLORIDE		R	16	15	14	15	15	15	15	15	15	14	15	14	0.2	250
	mg/L	T	18	–	–	16	–	–	–	–	17	17	–	16	mg/L	mg/L
COLOUR	HzU	R	9	–	–	1	–	–	–	–	–	–	–	7	0.5	5
		T	1	–	–	1	–	–	–	1	1	–	1	1	TCU	TCU
CONDUCTIVITY		R	307	301	281	289	287	248	296	293	291	282	283	279	0.01	
	umho/cm	T	342	–	–	293	–	–	–	–	–	–	–	286	UMHO/CM	
FIELD CHLORINE (COMBINED)		R													0.1	
	mg/L	T													mg/L	
FIELD CHLORINE (FREE)		R													0.1	
	mg/L	T													mg/L	
FIELD CHLORINE (TOTAL)		R													0.1	
	mg/L	T													mg/L	
FIELD PH		R													0.2	
		T														

TABLE 5.0: (cont'd.)

GENERAL CHEMISTRY (Cont'd)		19 84 JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	DWSP DETECTION LIMIT*	DRINKING WATER OBJ/ GUIDELINE[1]
FIELD TEMPERATURE	R														
°C	T														
FIELD TURBIDITY	R														1 FTU
FTU	T														
FLUORIDE	R	0.12	–	–	0.11	–	–	–	–	–	–	–	.011	0.01	2.4
mg/L	T	1.03	1.13	1.03	1.11	1.02	1.03	1.00	1.25	1.21	1.27	1.25	1.24	mg/L	mg/L
HARDNESS	R	139	–	–	134	–	–	–	–	–	–	–	122	0.5	
mg/L	T	140	–	–	125	–	–	–	–	126	128	–	123	mg/L	
MAGNESIUM	R	–												0.05	
mg/L	T	9.4	–	–	8.6	–	–	–	–	8.2	8.0	–	7.8	mg/L	c
NITRATE	R	.23	.30	.32	.35	.36	.22	.19	.23	.24	.19	.22	.18	0.05	10 mg/L
mg/L	T	.28	–	.30	.20	–	–	–	–	–	–	–	.15	mg/L	as N
NITRITE	R	.003	.004	.005	.004	.004	.004	.008	.009	.011	.007	.008	.009	0.005	1 mg/L
mg/L	T	.001	–	.01	.001	–	–	–	–	–	–	–	.001	mg/L	as N
NITROGEN TOTAL KJELDAHL	R	.34	.43	.45	.39	.43	.53	.53	.45	.31	.33	.33	.30	0.1	0.15
mg/L	T													mg/L	mg/L *
PH	R	8.1	8.1	8.2	8.1	8.0	8.1	7.8	7.9	7.9	8.0	7.9	7.9		
	T	7.5	7.3	7.4	7.3	7.4	7.4	7.3	7.2	7.2	7.4	7.4	7.4		
PHOSPHORUS FILTERED REACTIVE	R													0.01	
mg/L	T													mg/L	

TABLE 5.0: (cont'd.)

GENERAL CHEMISTRY (Cont'd)		1 9 84 JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	DWSP DETECTION LIMIT*	DRINKING WATER OBJ/ GUIDELINE[1]
PHOSPHORUS TOTAL	R	.023	.024	.028	.034	.031	.045	.030	.024	.038	.038	.083	.067	0.01	
mg/L	T	–												mg/L	
SODIUM	R	–												0.1	
mg/L	T	–	–	–	8.6	–	–	–	–	–	–	–	–	mg/L	
TOTAL SOLIDS	R													1	
mg/L	T													mg/L	
TURBIDITY	R	8.3	14.5	20.9	43.9	39.6	23.0	24.8	15.9	35.2	29.8	86.7	69.4	0.01	1
FTU	T	.12	.16	.17	.14	.14	.16	.18	.14	.15	.17	.14	.18	FTU	FTU
METALS															
ALUMINUM	R	–												0.003	
mg/L	T	.04	.02	.02	.01	.01	.02	.02	.02	.01	.02	.00	.01	mg/L	
ARSENIC	R	–												0.001	0.05
mg/L	T	–	–	–	.001	–	–	–	–	–	–	–	–	mg/L	mg/L
BARIUM	R	–												0.001	1
mg/L	T	–	–	–	.018	–	–	–	–	–	–	–	–	mg/L	mg/L
BERYLLIUM	R													0.001	
mg/L	T													mg/L	
BORON	R													0.02	5
mg/L	T													mg/L	mg/L
CADMIUM	R	–												0.0003	0.005
mg/L	T	–	–	–	.0003	–	–	–	–	–	–	–	–	mg/L	mg/L

TABLE 5.0: (cont'd.)

METALS (Cont'd)			19 84												DWSP DETECTION LIMIT*	DRINKING WATER OBJ/ GUIDELINE[1]
			JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC		
CHROMIUM		R	–												0.001	0.05
	mg/L	T	–	–	–	.001	–	–	–	–	–	–	–	–	mg/L	mg/L
COBALT		R													0.001	
	mg/L	T													mg/L	
COPPER		R	–												0.001	1
	mg/L	T	–	–	–	.003	–	–	–	–	–	–	–	–	mg/L	mg/L
CYANIDE		R													0.001	0.2
	mg/L	T													mg/L	mg/L
IRON		R	0.20	–	–	1.18	–	–	–	–	–	–	–	0.84	0.002	0.3
	mg/L	T	0.01	–	–	0.01	–	–	–	0.01	0.01	0.01	0.01	0.02	mg/L	mg/L c
LEAD	mg/L	R	–												0.003	0.05
		T	–	–	–	.003	–	–	–	–	–	–	–	–	mg/L	mg/L
MANGANESE		R	–												0.001	0.05
	mg/L	T	–	–	–	.001	–	–	–	–	–	–	–	–	mg/L	mg/L
MOLYBDENUM		R													0.001	
	mg/L	T													mg/L	
MERCURY		R													0.01	1
	ug/L	T													ug/L	ug/L
NICKEL		R	–												0.002	
	mg/L	T	–	–	–	.002	–	–	–	–	–	–	–	–	mg/L	

TABLE 5.0: (cont'd.)

METALS (Cont'd)		1 9 84 JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	DWSP DETECTION LIMIT*	DRINKING WATER OBJ/ GUIDELINE[1]
SELENIUM	R	–												0.001	0.01
mg/L	T	–	–	–	.001	–	–	–	–	–	–	–	–	mg/L	mg/L
SILVER	R	–												0.001	
mg/L	T	–	–	–	.005	–	–	–	–	–	–	–	–	mg/L	
TIN	R														
(no units available)	T														
URANIUM	R													0.002	.02
mg/L	T													mg/L	mg/L t
VANADIUM	R													0.001	
mg/L	T													mg/L	
ZINC	R	–												0.001	5
mg/L	T	–	–	–	.001	–	–	–	–	–	–	–	–	mg/L	mg/L h
PURGEABLES															
BENZENE	R													1	10
ug/L	T													ug/L	ug/L h
BROMOFORM	R													1	350
ug/L	T													ug/L	ug/L ++
CARBON TETRACHLORIDE	R	–												1	3
ug/L	T	∅	∅	∅	∅	–	–	–	–	–	–	–	–	ug/L	ug/L h
CHLOROBENZENE	R													1	100-300
ug/L	T													ng/L	ng/L h*

TABLE 5.0: (cont'd.)

PURGEABLES (Cont'd)		1 9 84 JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	DWSP DETECTION LIMIT*	DRINKING WATER OBJ/ GUIDELINE[1]
CHLORODIBROMOMETHANE	R	–												1	350
ug/L	T	5	5	5	3	–	6	0	4	4	6	6	6	ug/L	ug/L ++
CHLOROFORM	R	–												1	350
ug/L	T	13	13	31	21	–	30	16	31	21	46	36	30	ug/L	ug/L ++
1,2-DICHLOROBENZENE	R													1	400
ug/L	T													ug/L	ug/L e
1,3-DICHLOROBENZENE	R													1	400
ug/L	T													ug/L	ug/L e
1,4-DICHLOROBENZENE	R													1	400
ug/L	T													ug/L	ug/L e
DICHLOROBROMOMETHANE	R	–												1	350
ug/L	T	9	9	14	9	–	16	9	16	12	19	16	15	ug/L	ug/L ++
1,1-DICHLOROETHANE	R													1	
ug/L	T													ug/L	
1,2-DICHLOROETHANE	R													1	10
ug/L	T													ug/L	ug/L h
1,1-DICHLOROETHYLENE	R													1	.3
ug/L	T													ug/L	ug/L h
T,1,2-DICHLOROETHYLENE	R													1	
ug/L	T													ug/L	

TABLE 5.0: (cont'd.)

PURGEABLES (Cont'd)		19 84 JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	DWSP DETECTION LIMIT*	DRINKING WATER OBJ/ GUIDELINE[1]
DICHLOROMETHANE	R													5	40
ug/L	T													ug/L	ug/L c
1,2 DICHLOROPROPANE	R													1	
ug/L	T													ug/L	
ETHYLBENZENE	R													1	1400
ug/L	T													ug/L	ug/L e
ETHYLENE DIBROMIDE	R														
ug/L	T														
M-XYLENE	R													1	620
ug/L	T													ug/L	ug/L c
O-XYLENE	R													1 ug/L	620
ug/L	T														ug/L c
P-XYLENE	R													1	620
ug/L	T													ug/L	ug/L c
TOLUENE	R													1	100
ug/L	T													ug/L	ug/L c
1,1,2,2-TETRACHLOROETHANE	R													1	1.7
ug/L	T													ug/L	ug/L e
TETRACHLOROETHYLENE	R													1	10
ug/L	T													ug/L	ug/L h

TABLE 5.0: (cont'd.)

PURGEABLES (Cont'd)		JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	DWSP DETECTION LIMIT*	DRINKING WATER OBJ/ GUIDELINE[1]
		19 84													
1,1,1-TRICHLOROETHANE	R													1	1000
ug/L	T													ug/L	ug/L c
1,1,2-TRICHLOROETHANE	R													1	6
ug/L	T													ug/L	ug/L e
TRICHLOROETHYLENE	R	–												1	30
ug/L	T	Ø	Ø	Ø	Ø	–	–	–	–	–	–	–	–	ug/L	ug/L h
TOTAL TRIHALOMETHANES	R	–												3	350
ug/L	T	27	27	50	33	–	52	25	51	37	71	58	51	ug/L	ug/L ++
TRIFLUOROCHLOROTOLUENE	R													1	
ug/L	T													ug/L	
ORGANOCHLORINES															
ALDRIN	R													1	700
ng/L	T													ng/L	ng/L **
ALPHA BHC	R													1	700
ng/L	T													ng/L	ng/L c
ALPHA CHLORDANE	R													2	700
ng/L	T													ng/L	ng/L ***
BETA BHC	R													1	300
ng/L	T													ng/L	ng/L c
DIELDRIN	R													2	700
ng/L	T													ng/L	ng/L **

TABLE 5.0: (cont'd.)

ORGANOCHLORINES (Cont'd)		1984 JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	DWSP DETECTION LIMIT*	DRINKING WATER OBJ/ GUIDELINE[1]
ENDRIN	R													4	200
ng/L	T													ng/L	ng/L
GAMMA CHLORDANE	R													2	700
ng/L	T													ng/L	ng/L ***
HEPTACHLOR EPOXIDE	R													1	3000 +++
ng/L	T													ng/L	ng/L
HEPTACHLOR	R													1	3000
ng/L	T													ng/L	ng/L +++
HEXACHLOROBENZENE	R													1	10
ng/L	T													ng/L	ng/L h
HEXACHLOROBUTADIENE	R														
ug/L	T														
HEXACHLOROETHANE	R													1	19000
ng/L	T													ng/L	ng/L e
LINDANE	R													1	4000
ng/L	T													ng/L	ng/L
METHOXYCHLOR	R													5	100000
ng/L	T													ng/L	ng/L
MIREX	R													5	
ng/L	T													ng/L	

TABLE 5.0: (cont'd.)

ORGANOCHLORINES (Cont'd)		1984 JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	DWSP DETECTION LIMIT*	DRINKING WATER OBJ/ GUIDELINE[1]
OCTACHLOROSTYRENE	R													1	
ng/L	T													ng/L	
O,P-DDT	R													5	30000
ng/L	T													ng/L	ng/L d
OXYCHLORDANE	R													2	
ng/L	T													ng/L	
PCB TOTAL	R													20	3000
ng/L	T													ng/L	ng/L t
PENTACHLOROBENZENE	R													1	74000
ng/L	T													ng/L	ng/L e
P,P-DDD	R													5	d
ng/L	T													ng/L	
P,P-DDE	R													1	d
ng/L	T													ng/L	
P,P-DDT	R													5	d
ng/L	T													ng/L	
1,2,3,4-TETRACHLOROBENZENE	R													1	
ng/L	T													ng/L	
1,2,3,5-TETRACHLOROBENZENE	R													1	
ng/L	T													ng/L	

TABLE 5.0: (cont'd.)

ORGANOCHLORINES (Cont'd)		19 84 JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	DWSP DETECTION LIMIT*	DRINKING WATER OBJ/ GUIDELINE[1]
1,2,4,5-TETRACHLOROBENZENE	R													1	38000
ng/L	T													ng/L	ng/L e
THIODAN I	R													2	74000
ng/L	T													ng/L	ng/L ea
THIODAN II	R													4	74000
ng/L	T													ng/L	ng/L ea
THIODAN SULPHATE	R													4	
ng/L	T													ng/L	
TOXAPHENE	R														
(no units available)	T														
1,2,3-TRICHLOROBENZENE	R													5	10000
ng/L	T													ng/L	ng/L y
1,2,4-TRICHLOROBENZENE	R													5	15000
ng/L	T													ng/L	ng/L y
1,3,5-TRICHLOROBENZENE	R													5	10000
ng/L	T													ng/L	ng/L y
2,3,6-TRICHLOROTOLUENE	R													5	
ng/L	T													ng/L	
2,4,5-TRICHLOROTOLUENE	R													5	10000
ng/L	T													ng/L	ng/L g

TABLE 5.0: (cont'd.)

ORGANOCHLORINES (Cont'd)		19 84 JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	DWSP DETECTION LIMIT*	DRINKING WATER OBJ/ GUIDELINE[1]
2,6,A-TRICHLOROTOLUENE	R													5	
mg/L	T													ng/L	
TRIAZINES															
ALACHLOR	R														
ng/L	T														
AMETRINE	R													50	
ng/L	T													ng/L	
ATRATONE	R														
ng/L	T														
ATRAZINE	R													50	46000
ng/L	T													ng/L	ng/L I
BLADEX	R													100	10000
ng/L	T													ng/L	ng/L I
METOLACHLOR	R														
ng/L	T														
PROMETONE	R													50	
ng/L	T													ng/L	
PROMETRYNE	R													50	1000
ng/L	T													ng/L	ng/L I
PROPAZINE	R													50	
ng/L	T													ng/L	

TABLE 5.0: (cont'd.)

TRIAZINES (Cont'd)		19 84 JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	DWSP DETECTION LIMIT*	DRINKING WATER OBJ/ GUIDELINE[1]
SENCOR	R													100	
ng/L	T													ng/L	
SIMAZINE	R													50	10000
ng/L	T													ng/L	ng/L t
SPECIAL PESTICIDES															
2,4-D	R													100	100000
ng/L	T													ng/L	ng/L
2,4-D BUTYRIC ACID	R													200	18000
ng/L	T													ng/L	ng/L t
DICAMBA	R													100	87000
ng/L	T													ng/L	ng/L t
PENTACHLOROPHENOL	R													50	10000
ng/L	T													ng/L	ng/L h
PICLORAM	R													100	
ng/L	T													ng/L	
2,4-D PROPIONIC ACID	R													100	
ng/L	T													ng/L	
SILVEX	R													50	10000
ng/L	T													ng/L	ng/L
2,4,5-T	R													50	
ng/L	T													ng/L	

TABLE 5.0: (cont'd.)

SPECIAL PESTICIDES (Cont'd)		19 84 JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	DWSP DETECTION LIMIT*	DRINKING WATER OBJ/ GUIDELINE[1]
2,3,4,5-TETRACHLOROPHENOL	R													50	
ng/L	T													ng/L	
2,3,5,6-TETRACHLOROPHENOL	R													50	
ng/L	T													ng/L	
2,3,4-TRICHLOROPHENOL	R													100	
ng/L	T													ng/L	
2,4,5-TRICHLOROPHENOL	R													50	
ng/L	T													ng/L	
2,4,6-TRICHLOROPHENOL	R													50	10000
ng/L	T													ng/L	ng/L h
ORGANOPHOSPHOROUS PESTICIDES															
DIAZINON	R													50	14000
ng/L	T													ng/L	ng/L
DICHLOROVOS	R														
ng/L	T														
DURSBAN	R														
ng/L	T														
ETHION	R														
ng/L	T														
GUTHION	R														
ng/L	T														

TABLE 5.0: (cont'd.)

ORGANOPHOSPHOROUS PESTICIDES (Cont'd)		19 84 JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	DWSP DETECTION LIMIT*	DRINKING WATER OBJ/ GUIDELINE[1]
MALATHION	R														
ng/L	T														
METHYLPARATHION	R													50	7000
ng/L	T													ng/L	ng/L
METHYLTRITHION	R														
ng/L	T														
MEVINPHOS	R														
ng/L	T														
PARATHION	R													50	35000
ng/L	T													ng/L	ng/L
PHORBATE	R														
ng/L	T														
RELDAN	R														
ng/L	T														
RONNEL	R														
ng/L	T														
MASS SPEC.															
DI-N-BUTYL PHTHALATE	R													0.1	34000
ug/L	T													ug/L	ug/L e

TABLE 5.0: (cont'd.)

MASS SPEC. (Cont'd)		19 84 JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	DWSP DETECTION LIMIT*	DRINKING WATER OBJ/ GUIDELINE[1]
N-DICHLOROMETHYLENE- PENTACHLOROANALINE ug/L	R													0.1 ug/L	
	T														
DIPHENYL ETHER ug/L	R													0.1 ug/L	
	T														
FLUORANTHENE ug/L	R													0.1 ug/L	
	T														
HEXACHLOROPROPENE ug/L	R													0.1 ug/L	
	T														
METHYL PHENANTHRENE ug/L	R													0.1 ug/L	
	T														
NAPHTHALENE ug/L	R													0.1 ug/L	
	T														
PENTACHLOROBUTADIENE ug/L	R													0.1 ug/L	
	T														
PENTACHLOROPROPANE ug/L	R													0.1 ug/L	
	T														
PENTACHLOROPROPENE ug/L	R													0.1 ug/L	
	T														
PYRENE ug/L	R													0.1 ug/L	
	T														

TABLE 5.0: (cont'd.)

MASS SPEC. (Cont'd)		1984 JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	DWSP DETECTION LIMIT*	DRINKING WATER OBJ/ GUIDELINE[1]
TETRACHLORBUTANE	R													0.1	
ug/L	T													ug/L	
TETRACHLOROBIPHENYL	R													0.1	
ug/L	T													ug/L	
BACTERIA (1)															
RAW WATER:															
TOTAL COLIFORM 0-100/100 mL	R	9	6	8	10	9	8	8	8	8	9	8	7		
101-5000/100 mL	R			1				1	1			1	1		
TOTAL COLIFORM BKGD count/mL	R														
FECAL COLIFORM 0-10/100 mL	R	9	8	9	10	9	8	9	9	8	9	9	8	0	0/0.1 mL
STANDARD PLATE COUNT MF count/100mL	R													0	500
TREATED WATER:															
PRESENT/ABSENT TEST - P/A	A T	16	16	16	19	17	16	18	18	16	18	17	16		
	P T														
TOTAL COLIFORM BACKGROUND MF count/100mL	T													0	OWDO Bacti

(1) Number of tests done per month

TABLE 5.0: (cont'd.)

BACTERIA (Cont'd)		JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	DWSP DETECTION LIMIT*	DRINKING WATER OBJ/ GUIDELINE[1]
		19 84													
TREATED WATER: (Cont'd)															
FECAL COLIFORM MF count/100 mL	T													0	ODWO Bactl
STANDARD PLATE COUNT MF 0-500/mL	T	-	-	3	4	1	-	2	7	7	1	1	1		
>500/mL		-	-	0	0	0	-	0	0	0	0	0	1		
IF PRESENT/ABSENT TEST POSITIVE:															
Total Coliform 1-4/100 mL	T														
FECAL COLIFORM P/A	T														
E. COLI P/A	T														
AROMONAS P/A	T														
STAPH. AUREUS P/A	T														

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TABLE 5.0: (cont'd.) FOOTNOTES

1 = see individual footnotes for Agency of guideline origin

c = California State Department of Health Action Level

d = OWDO for DDT (contains other isomers such as OPDDT and PPDDT)

e = USEPA ambient guideline

ea = United States Environmental Protection Agency (USEPA) ambient level for endosulfan (contains other isomers)

ep = USEPA proposed maximum contaminant level for drinking water

g = suggested Health and Welfare Canada/Ontario Ministry of the Environment guideline value

h = World Health Organization (WHO) guideline

h* = World Health Organization (WHO) Odour Threshold

mg/L = milligrams per litre, parts per million, (ppm)

ng/L = nanograms per litre, parts per trillion, (ppt)

Presence/Absence = microbiological test to indicate presence or absence of coliform bacteria

R = raw water

T = Treated Drinking Water

t = ODWO Interim maximum acceptable concentration, (IMAC)

ug/L = micrograms per litre, parts per billion, (ppb)

y = New York State (Taste and Odour) proposed drinking water guideline

++ = total Trihalomethanes

+++ = combined total: Heptachlor and Heptachlor Epoxide

* = if other than DWSP Detection Limit

** = total of Aldrin and Dieldrin

*** = Chlordane is a mixture of alpha and gamma isomers

! = Ministry of the Environment and Health and Welfare Canada, (IMAC)

WPOS

TABLE 5.1: PLANT ST. THOMAS WATER QUALITY - 3-YEAR SUMMARY

GENERAL CHEMISTRY		1986 MAX	1986 MIN	1986 AVE	1985 MAX	1985 MIN	1985 AVE	1984 MAX	1984 MIN	1984 AVE	19__ MAX	19__ MIN	19__ AVE	DWSP DETECTION LIMIT*	DRINKING WATER OBJ/ GUIDELINE[1]
GENERAL CHEMISTRY															
ALKALINITY	R	105	96	101	124	95	106	106	98	103				0.2	
mg/L	T	92	90	91	88	73	81	100	91	93				mg/L	
AMMONIA TOTAL	R	0.065	0.008	0.023	.072	.009	.033	.101	.018	.041				0.05	
mg/L	T	0.005	0.005	0.005	.005	.005	.005	.10	.005	.029				mg/L	
CALCIUM	R													0.1	
mg/L	T	34.5	34.5	34.5										mg/L	
CHLORIDE	R	15	14	14.8	16	14	14.5	16	14	14.8				0.2	250
mg/L	T	18	14	15.8	16	16	16	18	16	17				mg/L	mg/L
COLOUR HzU	R	36.5	3.0	10.8	7	1	6.5	9	1	6				0.5	5
	T	1.0	1.0	1.0	2	-	1	1	-	1				TCU	TCU
CONDUCTIVITY	R	306	268	288	302	268	288	307	279	289				0.01	
umho/cm	T	326	286	303	311	285	295	342	286	307				UMHO/CM	
FIELD CHLORINE (COMBINED)	R													0.1	
mg/L	T													mg/L	
FIELD CHLORINE (FREE)	R													0.1	
mg/L	T													mg/L	
FIELD CHLORINE (TOTAL)	R													0.1	
mg/L	T													mg/L	
FIELD PH	R													0.2	
	T														

TABLE 5.1: (cont'd.)

GENERAL CHEMISTRY (Cont'd)		1986			1985			1984			19__			DWSP DETECTION LIMIT*	DRINKING WATER OBJ/ GUIDELINE[1]
		MAX	MIN	AVE	MAX	MIN	AVE	MAX	MIN	AVE	MAX	MIN	AVE		
FIELD TEMPERATURE	R														
°C	T														
FIELD TURBIDITY	R														1 FTU
FTU	T														
FLUORIDE	R	0.14	0.10	0.12	0.13	0.13	0.13	0.12	0.11	0.11				0.01	2.4
mg/L	T	1.32	1.13	1.22	1.27	1.39	1.18	1.27	1.00	1.13				mg/L	mg/L
HARDNESS	R	130	120	124	127	127	127	139	122	132				0.5	
mg/L	T	130	118	126	123	110	117	140	123	128				mg/L	
MAGNESIUM	R													0.05	
mg/L	T	8.4	8.4	8.4										mg/L	c
NITRATE	R	0.42	0.14	0.25	0.56	0.12	0.29	0.36	0.18	0.25				0.05	10 mg/L
mg/L	T	0.30	0.10	0.22	0.29	0.24	0.27	0.30	0.15	0.19				mg/L	as N
NITRITE	R	0.021	0.004	0.010	.015	.003	.009	.011	.003	.006				0.005	1 mg/L
mg/L	T	0.010	0.010	0.010	.001	.001	.001	.01	.001	.003				mg/L	as N
NITROGEN TOTAL KJELDAHL	R	0.53	0.26	0.36	0.56	0.26	0.40	0.53	0.30	0.40				0.1	0.15
mg/L	T	0.12	0.12	0.12										mg/L	mg/L *
PH	R	8.3	7.8	8.1	8.2	7.7	8.0	8.2	7.9	8.0					
	T	7.6	7.3	7.4	7.6	7.2	7.4	7.5	7.3	7.4					
PHOSPHORUS FILTERED REACTIVE	R													0.01	
mg/L	T													mg/L	

TABLE 5.1: (cont'd.)

GENERAL CHEMISTRY (Cont'd)		1986			1985			1984			19__			DWSP DETECTION LIMIT*	DRINKING WATER OBJ/ GUIDELINE[1]
		MAX	MIN	AVE	MAX	MIN	AVE	MAX	MIN	AVE	MAX	MIN	AVE		
PHOSPHORUS TOTAL	R	0.078	0.021	0.044	.129	.017	.061	.083	.023	.039				0.01	
mg/L	T				–		–			–				mg/L	
SODIUM	R													0.1	
mg/L	T													mg/L	
TOTAL SOLIDS	R													1	
mg/L	T													mg/L	
TURBIDITY	R	89.7	6.5	31.8	91.5	6.3	44.8	86.7	8.3	34.3				0.01	1
FTU	T	0.17	0.07	0.10	0.19	0.12	0.16	0.18	0.12	0.15				FTU	FTU
METALS															
ALUMINUM	R						–			–				0.003	
mg/L	T	0.03	0.01	0.02	0.03	0.01	0.02	0.04	0.00	.016				mg/L	
ARSENIC	R									–				0.001	0.05
mg/L	T							.001	.001	.001				mg/L	mg/L
BARIUM	R									–				0.001	1
mg/L	T							.018	.018	.018				mg/L	mg/L
BERYLLIUM	R													0.001	
mg/L	T													mg/L	
BORON	R													0.02	5
mg/L	T													mg/L	mg/L
CADMIUM	R									–				0.0003	0.005
mg/L	T							.0003	.0003	.0003				mg/L	mg/L

TABLE 5.1: (cont'd.)

METALS (Cont'd)			1986 MAX	1986 MIN	1986 AVE	1985 MAX	1985 MIN	1985 AVE	1984 MAX	1984 MIN	1984 AVE	19__ MAX	19__ MIN	19__ AVE	DWSP DETECTION LIMIT*	DRINKING WATER OBJ/ GUIDELINE[1]
CHROMIUM		R									—				0.001	0.05
	mg/L	T							.001	.001	.001				mg/L	mg/L
COBALT		R													0.001	
	mg/L	T													mg/L	
COPPER		R									—				0.001	1
	mg/L	T							.003	.003	.003				mg/L	mg/L
CYANIDE		R													0.001	0.2
	mg/L	T													mg/L	mg/L
IRON		R	5.45	0.17	1.03	1.60	1.60	1.60	1.18	0.20	0.74				0.002	0.3
	mg/L	T	0.05	0.01	0.02	0.04	0.01	0.02	0.02	0.01	0.01				mg/L	mg/L c
LEAD	mg/L	R									—				0.003	0.05
		T							.003	.003	.003				mg/L	mg/L
MANGANESE		R									—				0.001	0.05
	mg/L	T							.001	.001	.001				mg/L	mg/L
MOLYBDENUM		R													0.001	
	mg/L	T													mg/L	
MERCURY		R													0.01	1
	ug/L	T													ug/L	ug/L
NICKEL		R									—				0.002	
	mg/L	T							.002	.002	.002				mg/L	

TABLE 5.1: (cont'd.)

METALS (Cont'd)		19 86			1985			19 84			19__			DWSP DETECTION LIMIT[A]	DRINKING WATER OBJ/ GUIDELINE[1]
		MAX	MIN	AVE	MAX	MIN	AVE	MAX	MIN	AVE	MAX	MIN	AVE		
SELENIUM	R									–				0.001	0.01
mg/L	T							.001	.001	.001				mg/L	mg/L
SILVER	R									–				0.001	
mg/L	T							.005	.005	.005				mg/L	
TIN	R														
(no units available)	T														
URANIUM	R													0.002	.02
mg/L	T													mg/L	mg/L t
VANADIUM	R													0.001	
mg/L	T													mg/L	
ZINC	R									–				0.001	5
mg/L	T							.001	.001	.001				mg/L	mg/L h
PURGEABLES															
BENZENE	R													1	10
ug/L	T													ug/L	ug/L h
BROMOFORM	R													1	350
ug/L	T													ug/L	ug/L ++
CARBON TETRACHLORIDE	R									–				1	3
ug/L	T									ø				ug/L	ug/L h
CHLOROBENZENE	R													1	100-300
ug/L	T													ng/L	ng/L h[A]

TABLE 5.1: (cont'd.)

PURGEABLES (Cont'd)		19 86 MAX	19 86 MIN	19 86 AVE	19 85 MAX	19 85 MIN	19 85 AVE	19 84 MAX	19 84 MIN	19 84 AVE	19__ MAX	19__ MIN	19__ AVE	DWSP DETECTION LIMIT*	DRINKING WATER OBJ/ GUIDELINE[1]
CHLORODIBROMOMETHANE	R									–				1	350
ug/L	T	7	3	5	6	5	5	6	3	5				ug/L	ug/L ++
CHLOROFORM	R									–				1	350
ug/L	T	51	12	25	40	16	31	46	13	26				ug/L	ug/L ++
1,2-DICHLOROBENZENE	R													1	400
ug/L	T													ug/L	ug/L e
1,3-DICHLOROBENZENE	R													1	400
ug/L	T													ug/L	ug/L e
1,4-DICHLOROBENZENE	R													1	400
ug/L	T													ug/L	ug/L e
DICHLOROBROMOMETHANE	R									–				1	350
ug/L	T	17	9	11	20	12	16	19	9	13				ug/L	ug/L ++
1,1-DICHLOROETHANE	R													1	
ug/L	T													ug/L	
1,2-DICHLOROETHANE	R													1	10
ug/L	T													ug/L	ug/L h
1,1-DICHLOROETHYLENE	R													1	.3
ug/L	T													ug/L	ug/L h
T,1,2-DICHLOROETHYLENE	R													1	
ug/L	T													ug/L	

TABLE 5.1: (cont'd.)

PURGEABLES (Cont'd)		1986 MAX	1986 MIN	1986 AVE	1985 MAX	1985 MIN	1985 AVE	1984 MAX	1984 MIN	1984 AVE	19__ MAX	19__ MIN	19__ AVE	DWSP DETECTION LIMIT*	DRINKING WATER OBJ/ GUIDELINE[1]
DICHLOROMETHANE	R													5	40
ug/L	T													ug/L	ug/L c
1,2 DICHLOROPROPANE	R													1	
ug/L	T													ug/L	
ETHYLBENZENE	R													1	1400
ug/L	T													ug/L	ug/L e
ETHYLENE DIBROMIDE	R														
ug/L	T														
M-XYLENE	R													1	620
ug/L	T													ug/L	ug/L c
O-XYLENE	R													1 ug/L	620
ug/L	T														ug/L c
P-XYLENE	R													1	620
ug/L	T													ug/L	ug/L c
TOLUENE	R													1	100
ug/L	T													ug/L	ug/L c
1,1,2,2-TETRACHLOROETHANE	R													1	1.7
ug/L	T													ug/L	ug/L e
TETRACHLOROETHYLENE	R													1	10
ug/L	T													ug/L	ug/L h

TABLE 5.1: (cont'd.)

PURGEABLES (Cont'd)		19 86			19 85			1984			19__			DWSP DETECTION LIMIT*	DRINKING WATER OBJ/ GUIDELINE[1]	
		MAX	MIN	AVE	MAX	MIN	AVE	MAX	MIN	AVE	MAX	MIN	AVE			
1,1,1-TRICHLOROETHANE	R													1	1000	
ug/L	T													ug/L	ug/L	c
1,1,2-TRICHLOROETHANE	R													1	6	
ug/L	T													ug/L	ug/L	e
TRICHLOROETHYLENE	R									–				1	30	
ug/L	T						–			ø				ug/L	ug/L	h
TOTAL TRIHALOMETHANES	R									–				3	350	
ug/L	T	74	22	41	60	35	52	71	25	44				ug/L	ug/L	++
TRIFLUOROCHLOROTOLUENE	R													1		
ug/L	T													ug/L		
ORGANOCHLORINES																
ALDRIN	R													1	700	
ng/L	T													ng/L	ng/L	**
ALPHA BHC	R													1	700	
ng/L	T													ng/L	ng/L	c
ALPHA CHLORDANE	R													2	700	
ng/L	T													ng/L	ng/L	***
BETA BHC	R													1	300	
ng/L	T													ng/L	ng/L	c
DIELDRIN	R													2	700	
ng/L	T													ng/L	ng/L	**

TABLE 5.1: (cont'd.)

ORGANOCHLORINES (Cont'd)		19 86			19 85			19 84			19__			DWSP DETECTION LIMIT*	DRINKING WATER OBJ/ GUIDELINE[1]
		MAX	MIN	AVE	MAX	MIN	AVE	MAX	MIN	AVE	MAX	MIN	AVE		
ENDRIN	R													4	200
ng/L	T													ng/L	ng/L
GAMMA CHLORDANE	R													2	700
ng/L	T													ng/L	ng/L ***
HEPTACHLOR EPOXIDE	R													1	3000 +++
ng/L	T													ng/L	ng/L
HEPTACHLOR	R													1	3000
ng/L	T													ng/L	ng/L +++
HEXACHLOROBENZENE	R													1	10
ng/L	T													ng/L	ng/L h
HEXACHLOROBUTADIENE	R														
ug/L	T														
HEXACHLOROETHANE	R													1	19000
ng/L	T													ng/L	ng/L e
LINDANE	R													1	4000
ng/L	T													ng/L	ng/L
METHOXYCHLOR	R													5	100000
ng/L	T													ng/L	ng/L
MIREX	R													5	
ng/L	T													ng/L	

TABLE 5.1: (cont'd.)

ORGANOCHLORINES (Cont'd)		19 86			19 85			19 84			19__			DWSP DETECTION LIMIT*	DRINKING WATER OBJ/ GUIDELINE[1]
		MAX	MIN	AVE	MAX	MIN	AVE	MAX	MIN	AVE	MAX	MIN	AVE		
OCTACHLOROSTYRENE	R													1	
ng/L	T													ng/L	
O,P-DDT	R													5	30000
ng/L	T													ng/L	ng/L d
OXYCHLORDANE	R													2	
ng/L	T													ng/L	
PCB TOTAL	R													20	3000
ng/L	T													ng/L	ng/L t
PENTACHLOROBENZENE	R													1	74000
ng/L	T													ng/L	ng/L e
P,P-DDD	R													5	d
ng/L	T													ng/L	
P,P-DDE	R													1	d
ng/L	T													ng/L	
P,P-DDT	R													5	d
ng/L	T													ng/L	
1,2,3,4-TETRACHLOROBENZENE	R													1	
ng/L	T													ng/L	
1,2,3,5-TETRACHLOROBENZENE	R													1	
ng/L	T													ng/L	

TABLE 5.1: (cont'd.)

ORGANOCHLORINES (Cont'd)		1986			1985			1984			19__			DWSP DETECTION LIMIT*	DRINKING WATER OBJ/ GUIDELINE[1]
		MAX	MIN	AVE	MAX	MIN	AVE	MAX	MIN	AVE	MAX	MIN	AVE		
1,2,4,5-TETRACHLOROBENZENE	R													1	38000
ng/L	T													ng/L	ng/L e
THIODAN I	R													2	74000
ng/L	T													ng/L	ng/L ea
THIODAN II	R													4	74000
ng/L	T													ng/L	ng/L ea
THIODAN SULPHATE	R													4	
ng/L	T													ng/L	
TOXAPHENE	R														
(no units available)	T														
1,2,3-TRICHLOROBENZENE	R													5	10000
ng/L	T													ng/L	ng/L y
1,2,4-TRICHLOROBENZENE	R													5	15000
ng/L	T													ng/L	ng/L y
1,3,5-TRICHLOROBENZENE	R													5	10000
ng/L	T													ng/L	ng/L y
2,3,6-TRICHLOROTOLUENE	R													5	
ng/L	T													ng/L	
2,4,5-TRICHLOROTOLUENE	R													5	10000
ng/L	T													ng/L	ng/L g

TABLE 5.1: (cont'd.)

ORGANOCHLORINES (Cont'd)		1986			1985			1984			19__			DWSP DETECTION LIMIT*	DRINKING WATER OBJ/ GUIDELINE[1]
		MAX	MIN	AVE	MAX	MIN	AVE	MAX	MIN	AVE	MAX	MIN	AVE		
2,6,A-TRICHLOROTOLUENE	R													5	
mg/L	T													ng/L	
TRIAZINES															
ALACHLOR	R														
ng/L	T														
AMETRINE	R	<50	<50	<50										50	
ng/L	T													ng/L	
ATRATONE	R	<50	<50	<50											
ng/L	T														
ATRAZINE	R													50	46000
ng/L	T													ng/L	ng/L 1
BLADEX	R	<100	<100	<100										100	10000
ng/L	T													ng/L	ng/L 1
METOLACHLOR	R	<500	<500	<500											
ng/L	T														
PROMETONE	R	<50	<50	<50										50	
ng/L	T													ng/L	
PROMETRYNE	R	<50	<50	<50										50	1000
ng/L	T													ng/L	ng/L 1
PROPAZINE	R	<50	<50	<50										50	
ng/L	T													ng/L	

TABLE 5.1: (cont'd.)

TRIAZINES (Cont'd)		1986			1985			1984			19__			DWSP DETECTION LIMIT*	DRINKING WATER OBJ/ GUIDELINE[1]
		MAX	MIN	AVE	MAX	MIN	AVE	MAX	MIN	AVE	MAX	MIN	AVE		
SENCOR	R	<100	<100	<100										100	
ng/L	T													ng/L	
SIMAZINE	R	<50	<50	<50										50	10000
ng/L	T													ng/L	ng/L I
SPECIAL PESTICIDES															
2,4-D	R													100	100000
ng/L	T													ng/L	ng/L
2,4-D BUTYRIC ACID	R													200	18000
ng/L	T													ng/L	ng/L I
DICAMBA	R													100	87000
ng/L	T													ng/L	ng/L I
PENTACHLOROPHENOL	R													50	10000
ng/L	T													ng/L	ng/L h
PICLORAM	R													100	
ng/L	T													ng/L	
2,4-D PROPIONIC ACID	R													100	
ng/L	T													ng/L	
SILVEX	R													50	10000
ng/L	T													ng/L	ng/L
2,4,5-T	R													50	
ng/L	T													ng/L	

TABLE 5.1: (cont'd.)

SPECIAL PESTICIDES (Cont'd)		1986			1985			1984			19__			DWSP DETECTION LIMIT*	DRINKING WATER OBJ/ GUIDELINE[1]
		MAX	MIN	AVE	MAX	MIN	AVE	MAX	MIN	AVE	MAX	MIN	AVE		
2,3,4,5-TETRACHLOROPHENOL	R													50	
ng/L	T													ng/L	
2,3,5,6-TETRACHLOROPHENOL	R													50	
ng/L	T													ng/L	
2,3,4-TRICHLOROPHENOL	R													100	
ng/L	T													ng/L	
2,4,5-TRICHLOROPHENOL	R													50	
ng/L	T													ng/L	
2,4,6-TRICHLOROPHENOL	R													50	10000
ng/L	T													ng/L	ng/L h
ORGANOPHOSPHOROUS PESTICIDES															
DIAZINON	R													50	14000
ng/L	T													ng/L	ng/L
DICHLOROVOS	R														
ng/L	T														
DURSBAN	R														
ng/L	T														
ETHION	R														
ng/L	T														
GUTHION	R														
ng/L	T														

TABLE 5.1: (cont'd.)

ORGANOPHOSPHOROUS PESTICIDES (Cont'd)		19 86			19 85			19 84			19__			DWSP DETECTION LIMIT*	DRINKING WATER OBJ/ GUIDELINE[1]
		MAX	MIN	AVE	MAX	MIN	AVE	MAX	MIN	AVE	MAX	MIN	AVE		
MALATHION	R														
ng/L	T														
METHYLPARATHION	R													50	7000
ng/L	T													ng/L	ng/L
METHYLTRITHION	R														
ng/L	T														
MEVINPHOS	R														
ng/L	T														
PARATHION	R													50	35000
ng/L	T													ng/L	ng/L
PHORBATE	R														
ng/L	T														
RELDAN	R														
ng/L	T														
RONNEL	R														
ng/L	T														
MASS SPEC.															
DI-N-BUTYL PHTHALATE	R													0.1	34000
ug/L	T													ug/L	ug/L e

TABLE 5.1: (cont'd.)

MASS SPEC. (Cont'd)		1986			1985			1984			19__			DWSP DETECTION LIMIT*	DRINKING WATER OBJ/ GUIDELINE[1]
		MAX	MIN	AVE	MAX	MIN	AVE	MAX	MIN	AVE	MAX	MIN	AVE		
N-DICHLOROMETHYLENE-	R													0.1	
PENTACHLOROANALINE														ug/L	
ug/L	T														
DIPHENYL ETHER	R													0.1	
ug/L	T													ug/L	
FLUORANTHENE	R													0.1	
ug/L	T													ug/L	
HEXACHLOROPROPENE	R													0.1	
ug/L	T													ug/L	
METHYL PHENANTHRENE	R													0.1	
ug/L	T													ug/L	
NAPHTHALENE	R													0.1	
ug/L	T													ug/L	
PENTACHLOROBUTADIENE	R													0.1	
ug/L	T													ug/L	
PENTACHLOROPROPANE	R													0.1	
ug/L	T													ug/L	
PENTACHLOROPROPENE	R													0.1	
ug/L	T													ug/L	
PYRENE	R													0.1	
ug/L	T													ug/L	

TABLE 5.1: (cont'd.)

MASS SPEC. (Cont'd)		1986			1985			1984			19__			DWSP DETECTION LIMIT*	DRINKING WATER OBJ/ GUIDELINE[1]
		MAX	MIN	AVE	MAX	MIN	AVE	MAX	MIN	AVE	MAX	MIN	AVE		
TETRACHLORBUTANE ug/L	R T													0.1 ug/L	
TETRACHLOROBIPHENYL ug/L	R T													0.1 ug/L	
BACTERIA															
RAW WATER:															
TOTAL COLIFORM MF count/100mL	R														
TOTAL COLIFORM BKGD count/100mL	R														
FECAL COLIFORM MF count/100mL	R													0	0/0.1 mL
STANDARD PLATE COUNT MF count/100mL	R													0	500
TREATED WATER:															
PRESENT/ABSENT TEST	T														
TOTAL COLIFORM BACKGROUND MF count/100mL	T													0	OWDO Bacti

TABLE 5.1: (cont'd.)

BACTERIA (Cont'd)		1986			1985			1984			19__			DWSP DETECTION LIMIT*	DRINKING WATER OBJ/ GUIDELINE[1]
		MAX	MIN	AVE	MAX	MIN	AVE	MAX	MIN	AVE	MAX	MIN	AVE		
TREATED WATER: (Cont'd)															
FECAL COLIFORM MF count/100 mL	T													0	ODWO Bactl
STANDARD PLATE COUNT MF count/100mL	T														
IF PRESENT/ABSENT TEST POSITIVE:															
Total Coliform 1-4/100 mL	T														
FECAL COLIFORM P/A	T														
E. COLI P/A	T														
AROMONAS P/A	T														
STAPH. AUREUS P/A	T														

A0106A/eal

TABLE 5.1: (cont'd.) FOOTNOTES

1 = see individual footnotes for Agency of guideline origin

c = California State Department of Health Action Level

d = OWDO for DDT (contains other isomers such as OPDDT and PPDDT)

e = USEPA ambient guideline

ea = United States Environmental Protection Agency (USEPA) ambient level for endosulfan (contains other isomers)

ep = USEPA proposed maximum contaminant level for drinking water

g = suggested Health and Welfare Canada/Ontario Ministry of the Environment guideline value

h = World Health Organization (WHO) guideline

h* = World Health Organization (WHO) Odour Threshold

mg/L = milligrams per litre, parts per million, (ppm)

ng/L = nanograms per litre, parts per trillion, (ppt)

Presence/Absence = microbiological test to indicate presence or absence of coliform bacteria

R = raw water

T = Treated Drinking Water

t = ODWO Interim maximum acceptable concentration, (IMAC)

ug/L = micrograms per litre, parts per billion, (ppb)

y = New York State (Taste and Odour) proposed drinking water guideline

++ = total Trihalomethanes

+++ = combined total: Heptachlor and Heptachlor Epoxide

* = if other than DWSP Detection Limit

** = total of Aldrin and Dieldrin

*** = Chlordane is a mixture of alpha and gamma isomers

! = Ministry of the Environment and Health and Welfare Canada, (IMAC)

TABLE 6

WATER PLANT OPTIMIZATION STUDY

"ALGAE COUNT"

TABLE 6.0: ALGAE COUNT (A.S.U./mL)

MOE WPOS PROTOCOL

		1986	1985	1984	1983
JAN	Max.			116	
	Min.			30	
	Avg.			73	
	No. Tests	0	0	2	
FEB	Max.			136	
	Min.			129	
	Avg.			133	
	No. Tests	0	0	2	
MAR	Max.			728	
	Min.			475	
	Avg.			602	
	No. Tests	0	0	2	
APR	Max.			272	
	Min.			62	
	Avg.			147	
	No. Tests	0	0	3	
MAY	Max.			821	
	Min.			77	
	Avg.			449	
	No. Tests	0	0	2	
JUN	Max.			442	
	Min.			69	
	Avg.			256	
	No. Tests	0	0	2	

TABLE 6.0 (cont'd.) (A.S.U./mL)

		1986	1985	1984	1983
JUL	Max.			1146	
	Min.			276	
	Avg.			711	
	No. Tests	0	0	2	
AUG	Max.			185	
	Min.			163	
	Avg.			174	
	No. Tests	0	0	2	
SEP	Max.			216	
	Min.			120	
	Avg.			168	
	No. Tests	0	0	2	
OCT	Max.				
	Min.				
	Avg.				
	No. Tests	0	0	0	
NOV	Max.				
	Min.				
	Avg.				
	No. Tests	0	0	0	
DEC	Max.				
	Min.				
	Avg.				
	No. Tests	0	0	0	

TABLE 7

WATER PLANT OPTIMIZATION STUDY

"BACTERIOLOGICAL TESTING"

TABLE 7.0: BACTERIOLOGICAL TESTING 1986 (No. Of Analyses Per Category)

MOE WPOS PROTOCOL

		TOTAL COLI				FECAL COLI				FECAL STREP			
		A	B	C	D	A	E	F	G	A	H	I	J
JAN	R		8	1			6				7		
	T	16											
FEB	R		8				8				8		
	T	14											
MAR	R		7	1			7				7		
	T	16	2			2				4			
APR	R		8	1			9				9		
	T	18											
MAY	R		9				8				7		
	T	16				1				5			
JUN	R		9				9				9		
	T	18								2			
JUL	R		9				9				9		
	T	18				1				1	1		
AUG	R		7	1			8				8		
	T	16											
SEP	R		8	1			9				9		
	T	16	1							1			
OCT	R		7	2			8				8		
	T	18											
NOV	R		8				8				8		
	T	17								1			
DEC	R		7	1			8				8		
	T	15								3			

NOTE: All results are for 100 mL samples; tests carried out at MOE lab, Resources Road.

A = Absent
B = 1-100
C = 101-5000
D = >5000

E = 0-10
F = 11-500
G = >500

H = 0-1
I = 2-50
J = >50

TABLE 7.0: BACTERIOLOGICAL TESTING 1985 (No. Of Analyses Per Category)

MOE WPOS PROTOCOL

		TOTAL COLI				FECAL COLI				FECAL STREP			
		A	B	C	D	A	E	F	G	A	H	I	J
JAN	R		9				9				9		
	T	18											
FEB	R		8				8				8		
	T	16											
MAR	R		7	1			8				8		
	T	16								2			
APR	R		9				9				9		
	T	17											
MAY	R		9				7				7		
	T	17								3			
JUN	R		8				8				8		
	T	16											
JUL	R		9				9				9		
	T	17								1			
AUG	R		9				9				9		
	T	16	1							1			
SEP	R		8	1			9				9		
	T	18								2			
OCT	R		9				9				9		
	T	18								1			
NOV	R		4	4			7	1			7	1	
	T	16											
DEC	R		7	1			8				8		
	T	15								2			

NOTE: All results are for 100 mL samples; tests carried out at MOE lab, Resources Road.

A = Absent
B = 1-100
C = 101-5000
D = >5000

E = 0-10
F = 11-500
G = >500

H = 0-1
I = 2-50
J = >50

TABLE 7.0: BACTERIOLOGICAL TESTING 1984 (No. Of Analyses Per Category)

MOE WPOS PROTOCOL

		TOTAL COLI				FECAL COLI				FECAL STREP			
		A	B	C	D	A	E	F	G	A	H	I	J
JAN	R		9				9				9		
	T	16								2			
FEB	R		10	2			8				8		
	T	16								1			
MAR	R		8	1			9				9		
	T	16								1			
APR	R		10				10				10		
	T	19											
MAY	R		9				9				9		
	T	17								3			
JUN	R		8				8				8		
	T	16											
JUL	R		8	1			9				9		
	T	18											
AUG	R		8	1			9				9		
	T	18								4			
SEP	R		8				8				8		
	T	16								2			
OCT	R		9				9				9		
	T	18								1			
NOV	R		8	1			9				9		
	T	17								1			
DEC	R		7	1			8				8		
	T	16								2			

NOTE: All results are for 100 mL samples; tests carried out at MOE lab, Resources Road.

A = Absent
B = 1-100
C = 101-5000
D = >5000

E = 0-10
F = 11-500
G = >500

H = 0-1
I = 2-50
J = >50

APPENDIX D

TERMS OF REFERENCE

Purpose

To review the present conditions and determine an optimum treatment strategy for contaminant removal at the plant, with emphasis on particulate materials and disinfection processes.

Work Tasks

1. Receive an information package from the MOE. Review the information provided and meet with the MOE staff, if required, to discuss the project.
2. Document the quality and quantity of raw and treated waters.
3. Define the present treatment processes and operating procedures. Prepare a progress report on Works Tasks 1-3 for the Project Committee.
4. Assess the methods of efficient particulate removal which would utilize the present major capital works of the plant. Evaluate the particulate removal efficiency and sensitivity of operation, assuming optimum performance of the plant.
5. Assess current disinfection practices and possible improvement methods.
6. Describe possible short and long-term process modifications to obtain optimum disinfection and contaminant removal.
7. Prepare a draft report for the project committee's review.
8. Prepare the final report.

1. RECEIVE AN INFORMATION PACKAGE FROM THE MOE. REVIEW THE INFORMATION PROVIDED AND MEET WITH THE MOE STAFF, IF REQUIRED, TO DISCUSS THE PROJECT.

Elements of Work

(a) Receive an information package from the MOE concerning the plant and the study. This package includes a general terms of reference, a general table of contents for organizing the study in a manner consistent with other plant reports, the WPOS reporting tables and a copy of Ontario Drinking Water Objectives.

(b) Review the information and prepare for a meeting to initiate the work on the project, including preparation of a schedule of manpower and staff committments.

(c) Meet with the MOE to discuss the available data, the terms of reference, and the project staff and work schedule. If a consultant is carrying out more than one study it may not be necessary to meet with the MOE at the start of each study.

2. DOCUMENT THE QUALITY AND QUANTITY OF RAW AND TREATED WATERS.

Elements of Work

(a) Prepare a monthly summary of maximum, minimum, and average flows for the last three consecutive years (Table 1.0). Address any discrepancies which exist between raw and treated flow rates.

(b) Based on the above, briefly review and tabulate for the last three years, the monthly maximum, minimum, and average per capita flow for the total population served by the plant (Table 1.1). Compare the plant data with typical per capita flows for the local region. Indicate major consumers who may influence the figures.

(c) Document the methods of measuring the raw and treated water flow rates.

(d) Summarize, for the last three consecutive years, where available, the raw and treated water; turbidity, colour, residual aluminum/iron, pH, temperature and treatment chemical dosages (other than disinfection and fluoridation). The summary should indicate the monthly daily average and maximum and minimum day (Table 2.0).

For the same three year period, tabulate also the daily average for the typical seasonal months of January, April, July and October as well as other months in which problems with particulate removal occurred (Tables 2). Document enough data to define and evaluate those problems.

Record other data, such as particulate counting, suspended solids, and algae counting (Table 5.0) which could reflect on particulate removal efficiency.

Document the source and methods used in determining all information.

A comparison should be made between the plant and outside laboratory information to ascertain the relative validity of the data. For plant data, emphasis should be given to plant laboratory tests rather than continuous process control instruments.

(e) Summarize for the last three consecutive years, where available, the disinfectant demand, dosages (including all disinfection related chemicals and residuals) for all application points as well as fluoridation dosage and residual. The summary should indicate the monthly daily average and maximum and minimum day (Table 3.0).

For the same three year period, tabulate (Tables 3) the daily average for the typical seasonal months of January, April, July and October as well as other months in which problems with chlorine residuals and/or positive bacterial tests identified in Table 6. Document enough data to define and evaluate those problems.

Document the methods of dosage evaluation and residual measurements, and establish the validity of the data provided.

(f) Prepare a summary, based on at least three years of data, of the raw and treated water quality testing data for physical, microbiological, radiological, and chemical water quality information (Table 4). Document as much data as is needed to show possible seasonal trends in water quality. Where possible, show corresponding sets of raw and treated water quality information.

Document the source and methods used in determining all water quality information and establish the validity of the data, comparing plant and outside laboratory data.

(g) Tabulate, for the last three consecutive years, the raw and treated water bacterial test information at the plant (Table 6).

Document the source and methods used for all data provided.

(h) Document the water sampling systems (source, pump, line-material and size, vertical rise velocity sampling location) used in the plant (similar to DWSP Questionnaire in Appendix A).

(i) Prepare a summary of inplant testing including Test, Sampling Point, Testing Frequency, Reporting Frequency, Testing Instrumentation including calibration.

(j) Identify other water quality concerns, not related to particulate removal or disinfection, which should be considered as part of the assessment phase of this evaluation program.

3. DEFINE THE PRESENT TREATMENT PROCESSES AND OPERATING PROCEDURES. PREPARE A PROGRESS REPORT ON WORK TASKS 1-3 (8 COPIES), FOR THE PROJECT COMMITTEE.

Elements of Work

(a) Where drawings are available, assemble sufficient record drawings of a reduced size, to document the general site layout and the interrelationship of major plant components. If available, include a process and piping diagram (PAPD) of the plant operations.

(b) Prepare a simplified block schematic of all major plant components including chemical systems and indicating design parameters. Appendix B is an example of the required standard schematic.

(c) Prepare a photographic record of the plant facilities, illustrating all of the major plant components and chemical feed systems. The record should include approximately 30-40 coloured (9 cm x 12 cm) (or 10 cm x 15 cm) prints, suitably labelled. The progress and draft reports may include photocopies in lieu of the prints.

(d) Tabulate the design parameters for all the major plant components, with emphasis on the process operations, including chemical feeds. This information, as a minimum, must be consistent with the DWSP Questionnaire (Appendix A) and must be confirmed and verified by field observations. The design parameters should be evaluated at design, rated and actual operational flows.

(e) Prepare a summary of how the plant is operated, including chemical dosage control, such as jar testing information, filter backwashing procedures and initiation, and pumping and flow control.

(f) Document all reported and other apparent problems in plant operations and/or in the distribution system related to water quality. In addition list the health related parameters which exceed the Ontario Drinking Water Objectives (Table 7).

(g) Submit 8 copies of the progress report to the Prime Consultant for distribution to the Project Committee.

4. ASSESS THE METHODS OF EFFICIENT PARTICULATE REMOVAL WHICH WOULD UTILIZE THE PRESENT MAJOR CAPITAL WORKS OF THE PLANT. EVALUATE THE PARTICULATE REMOVAL EFFICIENCY AND SENSITIVITY OF OPERATION, ASSUMING OPTIMUM PERFORMANCE OF THE PLANT.

Elements of Work

(a) Assess the validity and implication of all information relating to particulate removal provided in Work Tasks 1 and 2 with emphasis on method, metering and sampling, etc.

(b) Using information provided in Work Tasks 1, 2 and 3 evaluate the plant's particulate removal efficiency. The basis of minimum particulate removal should be -1.0 F.t.u. It should, however, be recognized that it is desirable to strive for an operational level which is as low as is achievable.

(c) Conduct an evaluation of possible optimum performance alternatives. Include jar testing using established industry practice.

(d) Evaluate the feasibility of optimum removal using the existing plant capital works. This evaluation should consider the worst case water quality conditions, even though field testing data may not be available during the initial phase of the study (see Work Task 7).

(e) Describe the operational procedures, management strategies, and equipment required for various feasible alternatives. Estimate chemical dosages, level of operational expertise, and sensitivity of operation of the alternatives.

5. ASSESS CURRENT DISINFECTION PRACTICES AND POSSIBLE IMPROVEMENT METHODS.

Elements of Work

(a) Assess the validity and implication of all information relating to disinfection provided in Work Tasks 1, 2 and 3 with emphasis on method, metering and sampling etc.

(b) Using the information provided in Work Tasks 1, 2 and 3 evaluate the plant's ability to disinfect the water. The basis of minimum disinfection should be to ensure a water quality as described in the Ontario Drinking Water Objectives.

(c) Conduct an evaluation of possible optimum disinfection procedures for the plant, with consideration also given to the reduction of chlorinated by-products in the treated water.

(d) Evaluate the feasibility of the various alternatives using the existing plant capital works.

(e) Assess the relative merits of the alternatives. Describe the operational procedures, management strategies, and equipment required for the feasible alternatives. Estimate chemical dosages, level of operational expertise, and sensitivity of operation for the alternatives.

IBE POSSIBLE SHORT AND LONG-TERM PROCESS MODIFICATIONS TO
N OPTIMUM DISINFECTION AND CONTAMINANT REMOVAL.

f Work

re a list of modifications which should be considered for led implementation evaluation. Provide an estimated cost and ble schedule for implementation for each of the proposed ications.

s not the purpose of this study to provide a detailed mentation scheme for plant rehabilitation. It is, however, sary to scope the feasible short and long-term process ications required to achieve optimum disinfection and minant removals.

porate (a) above in the draft report.

7. PREPARE A DRAFT REPORT FOR THE PROJECT COMMITTEE'S REVIEW. (8 COPIES).

Elements of Work

(a) The report must include all information for Work Tasks 1-6.

The information must be organized and presented in a logical and co-ordinated fashion. A general table of contents (Appendix C) is provided for organizing the material in a manner consistent with other plant reports.

Submit the draft report for review by the Project Committee.

(b) Meet with the Project Committee on site at least one week after submission of the report.

(c) Prepare a separate letter report containing recommendation(s) concerning the need for additional field testing to cover quality conditions not available during the period of this study. The Project Committee may decide to delay completion of the final report until field data can be obtained to confirm the predictions of performance for the worst case water conditions.

8. PREPARE THE FINAL REPORT.

Elements of Work

(a) Conduct additional field testing if required. iscuss the implementations of the results with the Project Comm ttee if the results differ from the predicted performance.

(b) Amend the report as per review comments, incorporatin additional field data if required.

(c) Submit 25 copies of the final reports (including the colour photographs) to the MOE for distribution.